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40th WEDC International Conference, Loughborough, UK, 2017LOCAL ACTION WITH INTERNATIONAL COOPERATION TO IMPROVE AND
SUSTAIN WATER, SANITATION AND HYGIENE SERVICES**Diagnostic and decision-support tools for effective
faecal sludge management (FSM) services***Rebecca Scott (UK), Ian Ross & Michael Smith*

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Achieving effective faecal sludge management (FSM) from on-site sanitation systems is critical to improving sanitation in urban settlements. Research conducted in 2014-16 by OPM Ltd and WEDC, on behalf of and with the World Bank WSP, used extensive primary data from five cities in the global South to develop a comprehensive suite of FSM diagnostic and decision-support tools. This paper describes the development and use of the tools, while illustrating two key tools. The resulting suite of tools, together with associated resources, provides a comprehensive and usable basis to help guide FSM intervention options, informed by an understanding of existing FSM services, within the context of the enabling environment and political economy realities of the city.

Introduction to the FSM challenge

Poor people living in urban areas of many low-income countries commonly use either non-networked (on-site) sanitation facilities, or defecate in the open. Even when improved on-site sanitation options are used to contain faeces, in many cities only limited services exist for collection, transport and disposal or treatment of the resulting faecal sludge.ⁱ

Services for the emptying, transport, treatment and disposal of faecal sludge are collectively called faecal sludge management (FSM) services. These services can constitute an important component amongst the urban sanitation chains serving a given city. Achieving sustainable FSM services should therefore be viewed as a realistic short-, medium- or long-term measure to complement the services provided through networked sewerage systems, to ensure that all excreta is adequately managed through the sanitation service chain. Failure to ensure strong links throughout the chain results in untreated faecal sludge contaminating the environment, with serious implications for public health (Ross *et al*, 2016a).

Understanding FSM as part of urban sanitation

Interest in the development of FSM services has increased in recent years amongst WASH sector organizations, development partners and a growing number of national and local government agencies. Urban sanitation planning approaches and frameworks have recently developed to take account of the enabling environment for the range of sanitation services, including FSM.ⁱⁱ There remained however very few tools and guidelines to help city planners navigate complex FSM situations, despite increasing demand for them.

The Water and Sanitation Program of the World Bank (WSP) undertook a wide-ranging analysis of urban sanitation service challenges in 2012. This concluded that urban sanitation was being viewed primarily as an infrastructure issue, rather than a suite of services to ensure the adequate containment, transport, treatment and safe final disposal of faecal material. In doing so, the WSP recognised the lack of attention given to management of faecal sludge from on-site sanitation (i.e. non-sewered) systems, which comprise a significant and often majority component of urban sanitation services in low and middle income countries. These systems therefore need to be considered alongside all formal and informal sanitation pathways that contribute to the overall sanitary (or insanitary) status of a city (Hawkins *et al*, 2013).

Following on from this earlier analysis, WSP commissioned a desk-study of 12 cities to assess the status of sanitation services at a city level. The process adapted the methodology previously developed and used by the WSP to assess the status of a country's achievement in water and sanitation services against national targets. The desk-study resulted in city reports that incorporate a Service Delivery Assessment (SDA) scorecard and an accompanying faecal waste flow diagram (Peal *et al*, 2014a). These two tools proved to be significant in focusing people's attention around the major sanitation issues in each city under study – many of which highlighted the shortfall in FSM services – as well as pointing towards the steps that could realistically be taken to address those issues. The review also proposed that these tools and others be further developed (Peal *et al*, 2014b).

FSM research: process and methodology

Based on the results and recommendations of the desk-review, WSP wanted to extend the SDA and faecal waste flow diagram tools to take account of the political economy affecting incentives and blockages to FSM service improvements, as well as identify feasible technical and non-technical actions. These actions would need to start from where the city is currently at, in terms of sanitation service levels and the institutional factors (in the widest possible sense) that affect the development and sustainability of those services. Bringing the political economy aspects more explicitly into the framework of the enabling environment has been through use of Political Economy Analysis, resulting in a 'Prognosis for Change'. This identifies the interests and incentives that could block action, and possible entry points for overcoming them, which allows the heart of the complexity affecting urban sanitation service delivery and its development to be more openly presented and therefore responded to (Ross *et al*, 2016a).

Research carried out by OPM Ltd and WEDC at Loughborough University, led to the development of a suite of diagnostic tools (see Fig 1), underpinned by a comprehensive research framework, research questions, and range of data collection methods and instruments. To ensure results would give a credible reflection of the status of the city, a greater depth of investigation was conducted than in any of the previous studies. Using five city case studies, existing and new tools were tested in real-world settings using primary data, so as to inform both their development and application. The immediate objectives of the five city case studies were to field test the tools to capture quantitative and qualitative data on the sanitation situation in the city from a socio-economic perspective, specifically as it relates to FSM services. Studies were linked to a World Bank investment projects, wherever possible.

Extensive collection of both qualitative and quantitative data was carried out in each city, focusing on the hitherto largely ignored issue of non-sewered sanitation. Datasets were collected and analysed to represent the city as a whole (city-wide data), as well as purposively sampled from selected localities, such as unsewered areas, informal settlements, or geographically unstable areas. The research approach that was adopted acknowledges that solutions aiming to deliver decent sanitation to the city as a whole are required, while also emphasising that solutions for poor urban areas must not be left out of implementation plans. Primary data collection for the project was developed to follow this principle, and the analysis and the outputs of the tools flow from that. The studies also provided initial recommendations to guide discussions around future interventions in the sanitation sector in the city, by contributing credible data and analysis of findings (ibid, 2016a).

Research tools

The resulting tools are divided into two types. Firstly, the **diagnostic tools** aim to improve understanding of the nature of the problem affecting sanitation services and identify areas where action will be required. Then the **decision-support** tools aim to structure discussions around possible technical interventions, as well as their economic and financial implications. The stage of more detailed programme design can then be guided by the outputs of these tools, to further identify the specific political, institutional, financial and technical interventions necessary to deliver desired results – as well as cost up and prioritize those interventions.

Table 1 below summarises the tools and their objectives, as well as further related diagnostic tools which play an important role but were not developed as part of this initiative. Figure 1 then sets out how they fit together.

Table 1. Suite of tools and their objectives		
	Tool	Objectives
Diagnostic tools	Faecal Waste Flow Diagram (also known as shit flow diagram, or SFD)	Where does the fecal waste go? Represent where fecal waste goes, what proportion is managed and where the unmanaged portion ends up
	City Service Delivery Assessment (CSDA) for FSM	“What policies, laws, institutions, processes and budgets exist for FSM services? Where are there gaps? Assess the local enabling environment and quality of service delivery along the sanitation service chain, identifying areas for attention
	Prognosis for Change (developed from Political Economy Analysis)	“Why is it like this? Who benefits, who loses out? What factors could facilitate improvement of the services?” Identify the interests and incentives that could block action, and possible entry points for overcoming them
Decision-support tools	Service Delivery Action Framework	“Which aspects of the enabling environment need development next?” Guide identification of actions in relation to the enabling environment, necessary to deliver desired results
	Intervention Options Assessment	“Which technical options may work?” Guide for identification of technical interventions along the service chain – linking to program design guidelines
Tools developed by others	<i>Faecal sludge technical tools (various in development, e.g. Sandec/Eawag)</i>	<i>Quantify volumes and characteristics of sludge, using standard methods. Assess FS end-products to suit market potential, evaluate collection and transport options and optimized treatment processes for resource recovery.</i>
	<i>Urban Sanitation Status Index (developed by the World Bank)</i>	<i>Quantify and represent in cartographic form the status of sanitation services, disaggregated by neighborhood</i>
	<i>FSM finance tools (various in development)</i>	<i>Estimate the costs of fecal sludge management services</i>

The faecal waste flow diagram (SFD) acts as the starting point for the other tools: each subsequent tool provides further information on a different aspect of the overall analysis, to inform more detailed program design processes. From the SFD (Tool 1 in Figure 1) there are three ‘streams’ of information required for program design. The first relates to institutions and financing (to inform enabling environment interventions), the second to sludge and wastewater volumes and characteristics (to inform technical interventions) and the third to spatial data and costs to inform prioritization of interventions. Most of these tools apply to urban sanitation overall. The City Service Delivery Assessment (CSDA), as applied in this study, is FSM-specific, but could equally be applied, in a modified form, to urban sanitation in general.

For the enabling environment stream, the City Service Delivery Assessment (Tool 2 in Figure 1) assesses the quality of processes affecting service delivery, intermediate and resulting service outcomes along the sanitation service chain and diagnoses the main impediments within the current enabling environment to supporting the development, expansion and sustainability of FSM services. The Prognosis for Change/Political Economy Analysis (Tool 3 in Figure 1) is strongly linked to the CSDA, identifying the interests and incentives that could block action, and possible entry points for overcoming them. This then feeds into the Service Delivery Action Framework (Tool 4 in Figure 1) which suggests appropriate non-technical (or “soft”) interventions for improving FSM, as a function of the status of the enabling environment.

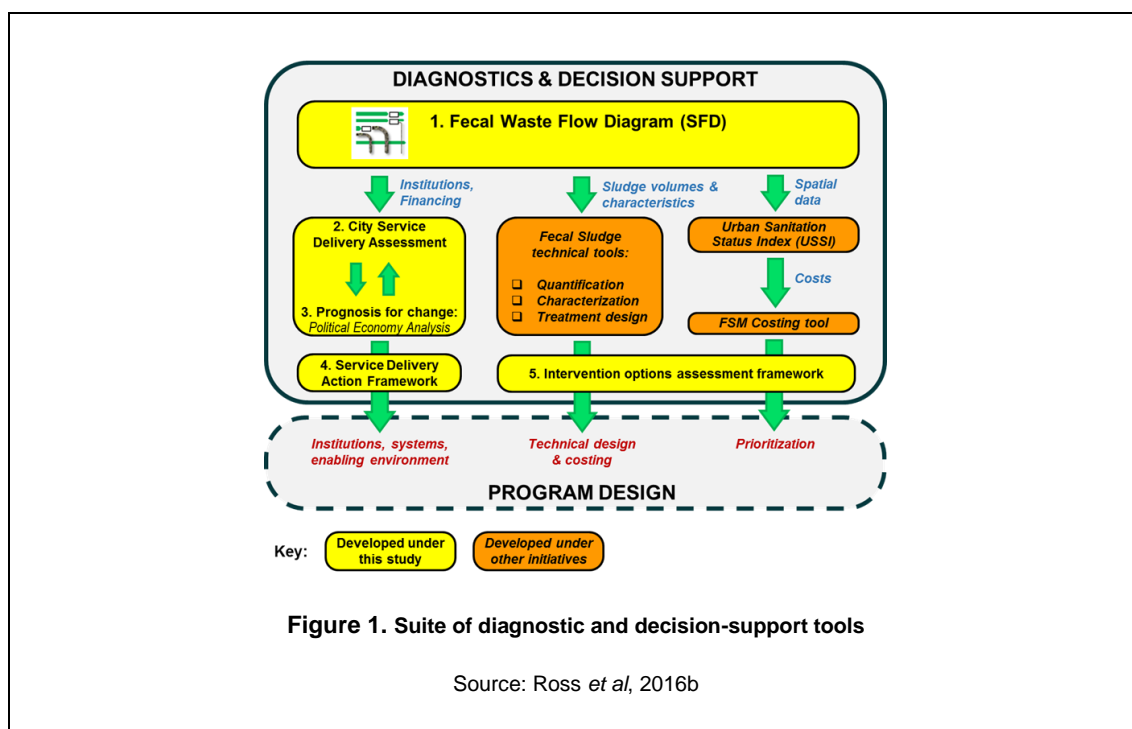
On the technical design stream, intervention options should be based on an understanding of the predominant characteristics of faecal sludge in the city, including how much of it there is to manage – which is not a simple question. This avoids inappropriate or ineffective technical options being proposed. SANDEC’s published material on urban sanitation and FSM are state-of-the-art resources for supporting the quantification, characterization and design of treatment for sludge (see for example Strande *et al*, 2014).

Finally, the prioritization stream helps decision-makers decide where to focus their efforts. The Urban Sanitation Status Index (USSI) tool of the World Bank WSP (see Hawkins and Muximpua, 2015), supports this by showing where deficiencies in sanitation are spatially distributed. Application of an FSM costing tool, such as developed by the Economics of Sanitation Initiative (<https://www.wsp.org/content/economic->

[impacts-sanitation](#)) allows for the financial and economic comparison of FSM service and infrastructure options, to support the selection of cost-effective interventions.

Together, the outputs of these tools provide comprehensive information on the physical situation which feed into the identification of technical intervention options. The selection process is supported by a simple, but informed assessment framework (Tool 5 in Figure 1).

The remainder of this paper provides a brief introduction and examples from the application of the first two of these Tools: the SFD and the CSDA. For a more in-depth explanation and detailed reports from the use of the full suite of Tools in each of the 5 city studies, readers are referred to the set of reports available to download from the World Bank website at: <http://www.worldbank.org/en/topic/sanitation/brief/fecal-sludge-management-tools>

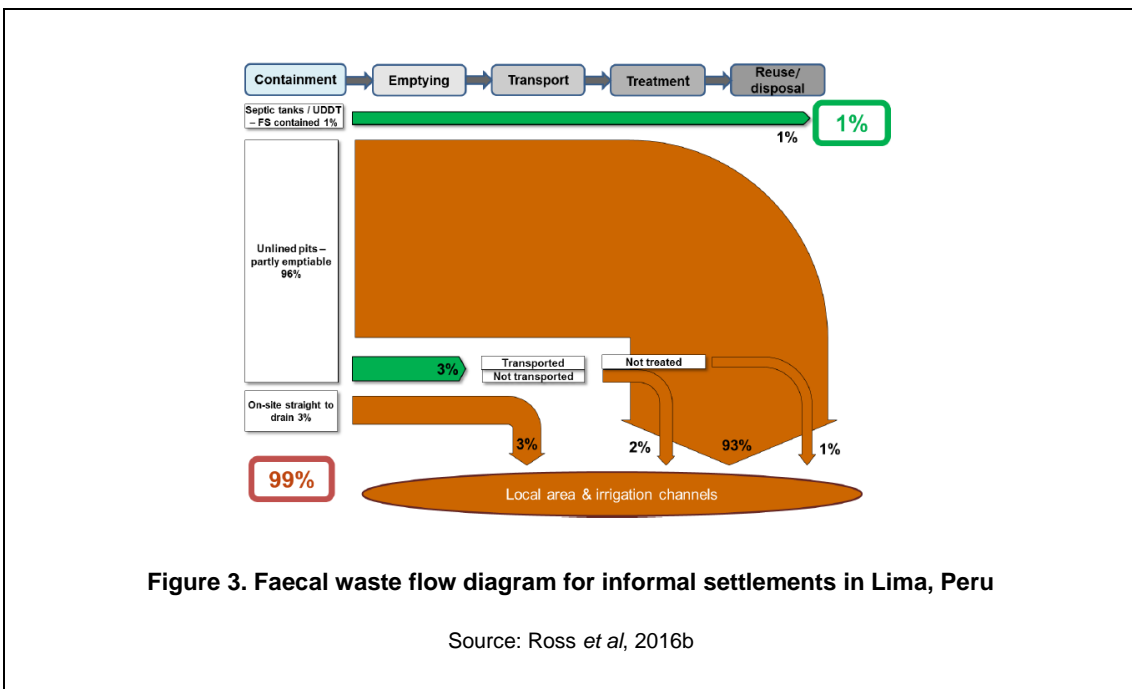
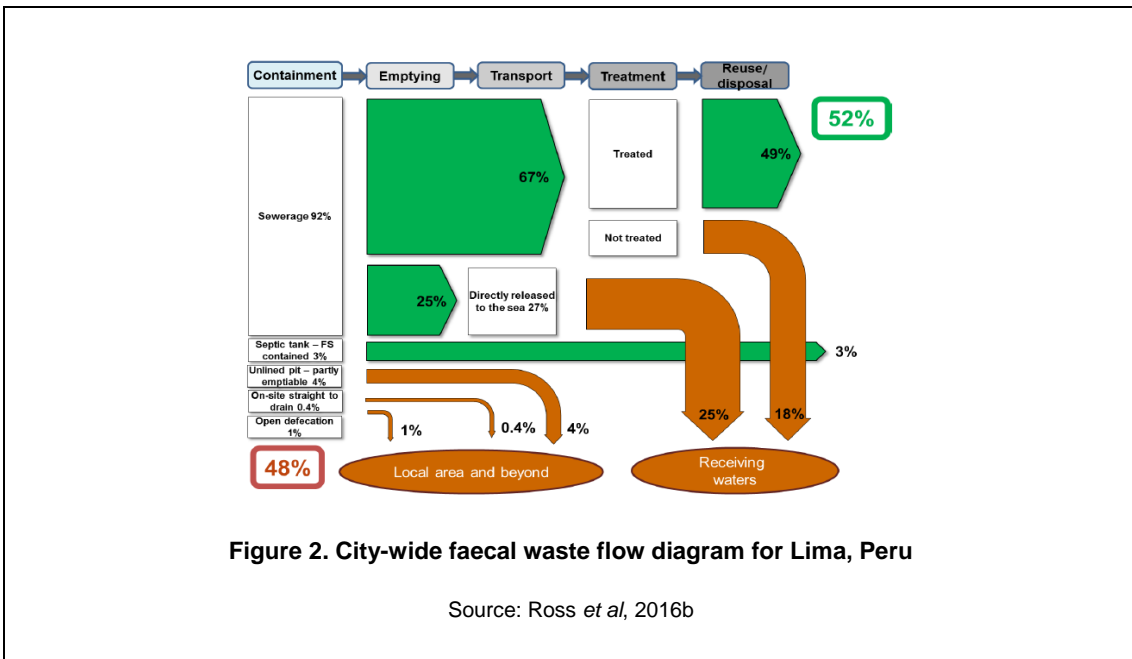


Tool 1: Faecal Waste Flow Diagram (SFD)

A Faecal Waste Flow Diagram (‘shit flow’ diagram, or SFD) is a credible visualisation of how faecal waste (consisting of both faecal sludge and wastewater) flows along the sanitation service chain for a given population (e.g. city-wide, informal settlements).

The aim of an SFD is to give a compelling visual summary of a city’s sanitation chains, specifically showing at which stages problems need to be addressed. At each stage of the chain, the proportion of faecal waste that is effectively managed continues as a green arrow, while any proportion identified as ineffectively managed “escapes” from the service chain and turns into a brown arrow, representing faecal pollution of the residential and natural environment. Data sources used to develop the figures for the diagrams in this research included household surveys (up to 720 per city), key informant interviews and focus group discussions, observation of service provision, transect walks, measurements at treatment facilities, published and secondary (grey) literature.

Figures 2 and 3 show examples of faecal waste flow diagrams for Lima, Peru. The first represents a city-wide picture, while the second represents the situation for informal settlements in the city. This is made possible by the sampling approach taken in the primary surveys, for which details are given in the full reports on the World Bank website. This separate analysis allows decision-makers to focus on delivering city-wide services which are also poor-inclusive.



As illustrated in the Lima case, the situation in slums is much worse than the city-wide picture, with far more faecal waste going directly into the local area, especially via poorly built unlined pits. This may help inform the development of poor-inclusive intervention options, for example improvements to on-site containment.

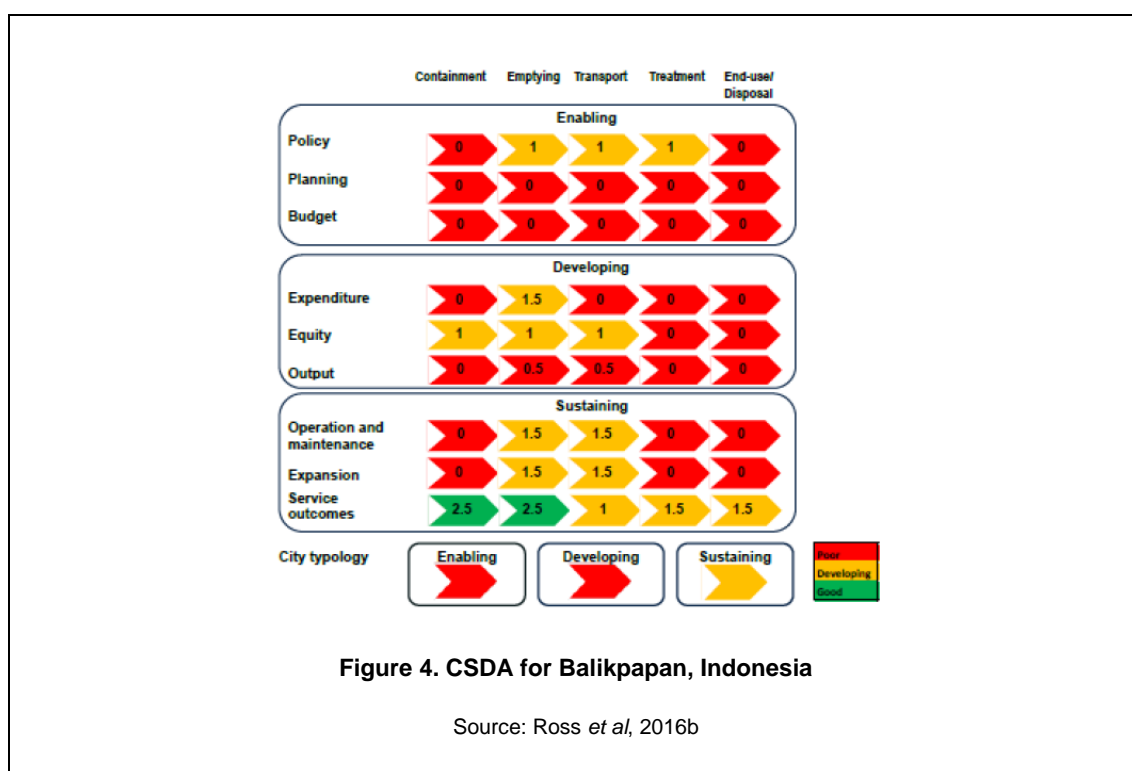
Tool 2: City Service Delivery Assessment (CSDA)

The CSDA provides a structured assessment, based on responding to predefined questions on FSM service performance through all stages of the service chain. Questions respond to objective criteria that are scored and presented visually in a colour-coded scorecard. The process and CSDA output answers overarching questions about the quality of the current *enabling environment*, the extent of FSM service *development* and the commitment to FSM service *sustainability*. A resulting CSDA scorecard shows areas of strength and

weakness for FSM in a city and helps identify priority areas for action, e.g. establishing plans and associated budgets to improve FSM services, or focusing on developing poor-inclusive technical interventions.

The example shown in Figure 4, from the Balikpapan city study, highlights that while certain policies exist and services are being provided to some extent (e.g. trucks emptying to a sludge treatment plant), areas of weakness remain along the chain. These are primarily in relation to the planning, budgeting and service outputs. Low scoring for the latter is mainly related to the lack of capacity of service providers to meet demand, and the quality of services sufficient to protect against public health risks. Looking at the columns of the CSDA, which represents a particular step in the service chain, it can be seen that in Balikpapan, treatment and disposal of faecal sludge are clearly weaknesses.

The process of developing the CSDA is important and requires key stakeholders to discuss all stages of the sanitation service chain and use the evidence about the current situation to agree appropriate scores. It is primarily an evidence based qualitative analysis, based on a review of key documents and interviews with stakeholders at the city level presented in an intuitive and well-structured way. The CSDA aims is to be objective and transparent, so the analysis is clear and stakeholders can engage with it and update it over time as the situation improves.



Key lessons and recommendations

In each city case study, a set of diagnostic and decision-support tools was applied based on primary and secondary data collection. Overall, the case studies confirmed the importance of non-networked sanitation in many developing country cities, and deficiencies in the management of services to manage the resulting faecal sludge. They also showed how diagnostic and decision-support tools can be useful in informing interventions to address these problems.

The tools presented in this paper are available for use by anybody, and their use is encouraged. Key audiences for the outputs of these tools are government decision-makers, development banks, utilities and municipal authorities. They are primarily intended for carrying out a sanitation situation diagnosis and the preliminary selection of intervention options, bringing a focus to each part of the sanitation service chain. They will be particularly useful at the project identification and preparation stage. However, much of the data collected will also be useful later in the design of interventions.

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ⁱ Faecal sludge can be defined as raw or partially-digested faeces and urine, in slurry or semi-solid form, derived from excreta and blackwater (Strande *et al*, 2014) associated with onsite sanitation technologies and therefore not transported in a sewer (Tilley *et al*, 2014). It typically also includes a variable amount of contaminated wastewater, often mixed with solid waste, menstrual hygiene materials and other waste dropped into toilets or directly into pits.

ⁱⁱ The enabling environment in this context consists of the complex mix of political reform, legislation, demand and economic drivers for urban sanitation. It can refer to the wider conditions within which sanitation service chains operate and describe “the inter-relationships between technical and non-technical elements identified as essential to support sanitation service delivery” (Medland *et al*, 2016, p. 498).