SFD Promotion Initiative

Domiz 2 Syrian Refugee Camp
Kurdistan Region of Iraq

Final Report

This Comprehensive SFD Report was prepared by GIZ.

Date of production: 25 July 2019

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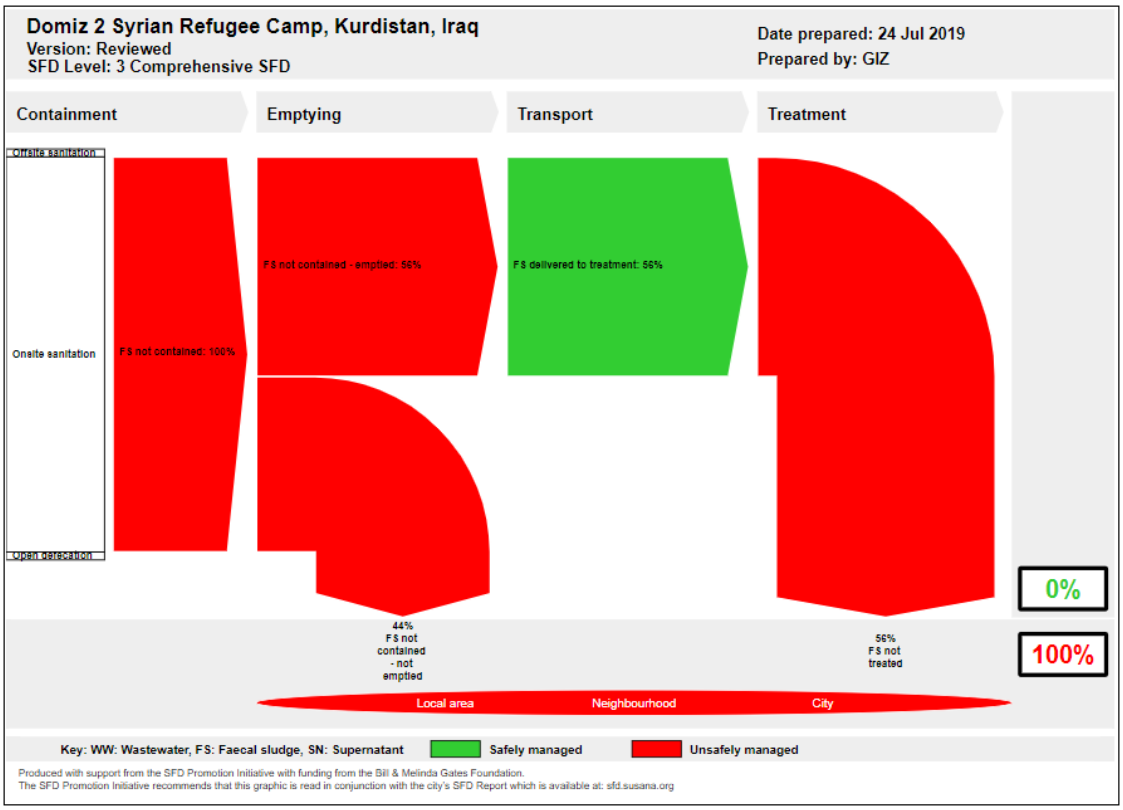
1. The Diagram



2. Diagram information

Desk or field based:

SFD is based on field work and assessments carried out in Domiz 2. This was part of the same assessment carried out for Domiz 1 camp and so much of the information is presented similarly, using similar examples.

Produced by:

GIZ (Martin O' Malley, who was deployed to UNHCR Duhok by RedR Australia, under funding from GIZ)

Update Input by:

In 2021 the following parties contributed key information to the review and update of this report, supporting the development of the Smart Sanitation Concept in the Duhok area: -

- GIZ
- GOPA Infra
- UPM

Status:

This is the Final SFD.

Date of production:

25/07/2019

3. General city information

Domiz 2 Syrian refugee camp is located on the outskirts of the Domiz Township, near the city of the Duhok, in the Kurdistan Region of Iraq. The camp was intended to be temporary in nature to provide shelter to those fleeing the war in Syria. Having been established in 2013 and currently being expanded by 160 shelters in July 2019, UNHCR Duhok staff believe that it is now reasonable to expect that the camp will be in place for the medium to long term.

At the time of writing, the registered population of the camp is 9,895. This remains relatively static, other than the estimated 3% annual population growth rate that has been applied. No significant population movements are known, such as for holidays.

Sanitation is provided to each shelter, with black water (toilet waste only) going to either septic tanks or holding tanks.

4. Service delivery context

Domiz 2 camp infrastructure development was carried out in a reasonably planned way, compared to its neighbour, Domiz 1 camp. The sanitation was laid out so that all shelters had the toilet (capture/containment) connected to a black water tank (containment), either septic tank or holding tank.

Some infrastructural improvements have been carried out in the camp in the years since it was first established. More recently, the focus has been on reducing the ongoing operation and maintenance costs by providing all septic tanks with soak pits in the camp, rather than continuing holding tanks.

The current sanitation infrastructure in Domiz 2 camp generally comprises of grey water and black water being separated at household level, with black water going to septic tanks, which are connected to soak pits, or to holding tanks. Because the infiltration capacity of the soils is generally less than the liquid loading applied, the septic tanks are being desludged on up to twice a month, with many acting as holding tanks only and being emptied up to 4 times a month.

Figure 1:Recent Septic tank & soak pit design, Domiz 1. Similar construction in Domiz 2. (Source: Author, 2018)

During the sanitation assessment it was established that the holding tanks are in fact lined pits with semi permeable walls and open bottom and are not connected to a soak pit. These pits are also sometimes called septic tanks, as they have some of the characteristics of these such as two chambers, with partition wall. They are built with unplastered block work.

Grey water is directed from within to the household's into the street drainage for collection through V-shaped channels, which also collect surface run off and then deliver this through increasingly larger channels into the natural drainage.

The desludged material is dumped into the environment without any treatment, about 2km from the camp, at a designated dumping site. However, it is a regular occurrence that, owing to the pressure on the desludging trucks, they frequently empty near the Domiz 2 camp, in an informal dumping site. Its noted that the end effect is the same, as both locations are simply points where the material is emptied into the environment and the catchment is part of Mosul Dam.

Figure 2: Desludged material being dumped at the designated site, near Domiz 1 Camp. (Source: Author)

It is noted that this is the same process for the host community also. In most situations in KRI, including the host community, black water is considered to be toilet water only and grey water is all of the other water outlets, including kitchen, washing, showers and laundry

5. Service outcomes

Existing service provision consists of desludging from the septic tanks & lined pits. There are 2 trucks working in Domiz 2 and they operate 7 days a week for approximately 8 hours a day. The 2 trucks work constantly to keep up with the demand during the summer. In wintertime, the trucks are almost always behind in terms of keeping the tanks emptied as required, most probably related to inflow and infiltration of surface and ground water into the tanks.

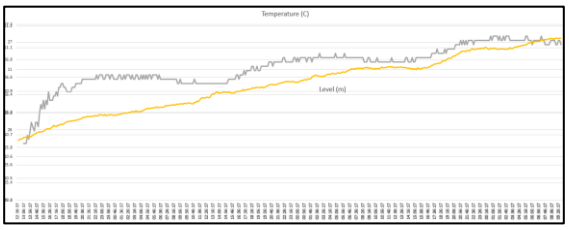


Figure 3: Monitoring of temperatures and levels in tanks, showing the influence of rainfall & grey water inflow, 344 Adar, Domiz 2. (Source: Author, 2019)

The operational hours are restricted to 8 hours because there are many tanks within shelters and BRHA try to avoid disturbing people as much as possible. If one of the trucks breaks down, this then puts pressure on the other to take up the extra demand.

As a result of the black and grey water being put to ground, the risk of contamination of groundwater has always been significant and in testing of the water supply in nearby Domiz 1 in 2017 it was found that the water had high levels of Nitrogen and Faecal Coliforms present, indicating not fit for purpose. This is a good indicator of the risk to the groundwater from the camp.

Figure 4: Grey water collection channel system, Domiz 2. (Source: Author 2019)

The level of treatment that the black water receives through the septic tanks is questionable and it is highly likely that the liquid going to the ground is contaminated.

6. Overview of stakeholders

Domiz 2 camp is being managed and operated by an organization called the Board of Relief and Humanitarian Affairs (BRHA), which was established by the Kurdistan Regional Government to deal with camp management in refugee and IDP camps. The funding for this organization is currently coming from various humanitarian actors, UN, and NGO.

The management of the camp is carried out with the support of various government departments, called Directorates.

Table 1: Stakeholders Domiz 2 Camp (Source: Author)

Key Stakeholders	Institutions / Organizations /
Public Institutions	BRHA Directorate of Municipalities Directorate of Water Outskirts Directorate of the Environment Directorate of Sewerage GIZ UNICEF UNHCR
Non-governmental Organizations	ACTED Peace Winds Japan

7. Credibility of data

Data has been collected from the field mainly, but also from discussions with various engineers and managers in Directorates and humanitarian organizations.

The collection of the data was part of a broader project looking into the issues and options for the sanitation system in Domiz 1 camp. This has been detailed more thoroughly in a report titled “Domiz 1 Syrian Refugee Camp Sanitation Assessment & Concept Options Report”, dated 04 June 2019 and prepared by RedR Australia Deployee Martin O’ Malley.

The data was collected over a 3-month monitoring period of intensive assessments on site through the 2019 Ramadan period and part of the summer, to get a broad and thorough understand of the issues.

8. Process of SFD development

Development of the SFD was based on the known observations in the field on the different types of containment and desludging, as well as familiarity with the operational system over a year.

The level of confidence around the information used in compiling this SFD is high.

The SFD accurately reflects the reality of the situation on the ground. It has been reviewed and updated in 2021, but updates are to layout and details of the system. The contents relate to the situation as it was in 2019 at the time of the assessment, even though there have been some changes to one of the containment types and the construction of a new treatment plant.

9. List of data sources

Data sources used to produce the SFD are as follows:

- Domiz 1 Syrian Refugee Camp Sanitation Assessment & Concept Options Report, dated 04 June 2019 and prepared by RedR Australia Deployee Martin O' Malley
- Duhok City Wastewater and Storm Water Master Plan
- Domiz 2 Desludging Assessment

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Abbreviations

KRI	Kurdistan Region of Iraq
KRG	Kurdistan Regional Government
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
UN	United Nations
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations International Children's Emergency Fund
GOPA	Gesellschaft für Organisation, Planung und Ausbildung mbH
UPM	Umwelt-Projekt-Management GmbH
NGO	Non-Governmental Organisation
SFD	Shit Flow Diagram, also called Excreta Flow Diagram
WASH	Water, Sanitation and Hygiene
CCCM	Camp Coordination and Camp Management
BRHA	Board of Relief and Humanitarian Affairs
CERF	Central Emergency Response Fund
HRP	Humanitarian Response Plan
KAP	Knowledge Attitudes and Practices (Survey)
WWTP	Wastewater Treatment Plant
BOD	Biochemical Oxygen Demand
m	Metre
m^3	Cubic Metre
l	Litre
l/p/d	Litres per person per day
km	Kilometre

1 City context

Domiz 2 Syrian Refugee Camp was established in 2013 in Duhok, Kurdistan Region of Iraq (KRI), opening in December of that year, in response to the influx of refugees from the war in Syria. According to the camp profile on the UNHCR Operational Data Portal website[1], the population was 9,895 registered refugees, as of 25 June 2018, the period when this assessment started (For consistency this number will be maintained). This does not include "visitors", of which there is believed to be a significant number, though there is no current accurate assessment. The figure used for annual population growth in the camp is 3%, according to camp management. Currently, the camp population is stable, with some expansions happening from time to time, but no major increase or decrease and this would be expected to continue for the duration of the camp.

Visitors to the camp are considered to be mainly relatives who live in other camps or cities and who stay for more than one night. BRHA acknowledge that they do not have reliable figures for visitors, as there is currently no way to account for them. It was also mentioned by BRHA that some of the visitors could be relations of registered refugees provided with assistance in the camp, who do not wish to register themselves, for various reasons.

Domiz 2 camp is located approximately 20km to the southeast of Duhok city, along the Mosul–Duhok highway. The camp was created as a separate settlement from the Domiz 1 refugee camp and the Domiz Township.

[1] https://data2.unhcr.org/en/documents/details/64278

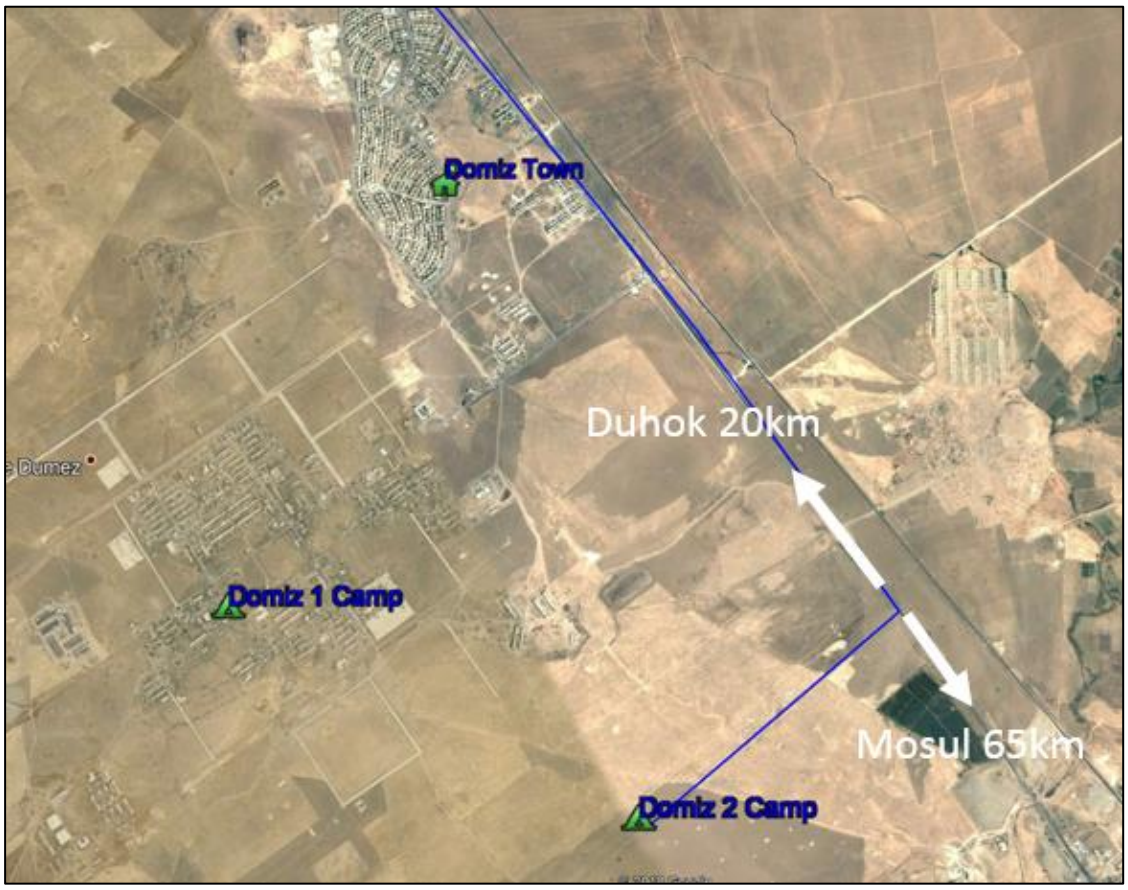

Figure 5: Domiz 2 Camp Location (Source: Google Maps, 2019)

The area is generally undulating, and arable farming is the main land use in the area, with one crop of wheat usually taken from the area. Some grazing also takes by roving, tended herds of mixed sheep and goat.

The soil is generally a sandy clay that overlies sandstone. The thickness of the soil layer varies, though is generally accepted as approx. 1.5m deep and the sandstone is granular until down to 5m deep, as indicated by percolation tests carried out by Dr. Najdat S. Abdulkhaliq of University of Duhok.

The climate in the area experiences some significant variations from summer to winter in terms of temperature and rainfall, as indicated in figure 6 below.

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature (°C)	5.7	7.5	11	15.7	22	27.9	31.9	31.4	27	20.5	13.7	7.6
Min. Temperature (°C)	1.2	2.5	5.5	9.6	14.8	19.6	23.3	22.6	18.3	12.8	7.8	3
Max. Temperature (°C)	10.3	12.5	16.5	21.9	29.3	36.3	40.5	40.2	35.8	28.2	19.6	12.3
Avg. Temperature (°F)	42.3	45.5	51.8	60.3	71.6	82.2	89.4	88.5	80.6	68.9	56.7	45.7
Min. Temperature (°F)	34.2	36.5	41.9	49.3	58.6	67.3	73.9	72.7	64.9	55.0	46.0	37.4
Max. Temperature (°F)	50.5	54.5	61.7	71.4	84.7	97.3	104.9	104.4	96.4	82.8	67.3	54.1
Precipitation / Rainfall (mm)	131	156	148	108	42	0	0	0	1	20	78	126

The difference in precipitation between the driest month and the wettest month is 156 mm. The average temperatures vary during the year by 26.2 °C.

Figure 6: Duhok weather by month. (Source: Weatheronline.com, 2019)

The undulating nature of the landscape gives rise to several sub-catchments within the camp, which influence the drainage of the sanitation system, and which influence the services layout. Water is stored at the high point in the camp and then gravitates through a pipe network to the various areas. Similarly, the containment systems are located at the low point of shelter blocks so as to allow the blackwater to flow under gravity from the individual shelters to the location of the containment.

2 Service delivery context description/analysis

Domiz 2 Syrian refugee camp is located on the outskirts of the Domiz Township, near the city of the Duhok, in the Kurdistan Region of Iraq. The camp was intended to be temporary in nature to provide shelter to those fleeing the war in Syria. Having been established in 2013 and consisting of two quarters, Golan and Adar as shown in figure 7. The camp was expanded in 2017, with the Harem quarter added, as shown in figure 8, and is currently being further expanded by 160 shelters in July 2019. UNHCR Duhok staff say that it is now reasonable to expect that the camp will be in place for the medium to long term, based on feedback from the population within the camp and from the fact that most families are expanding their shelters and making them more sturdy and secure, presumably on the basis that they think they will be there for a further longer period.

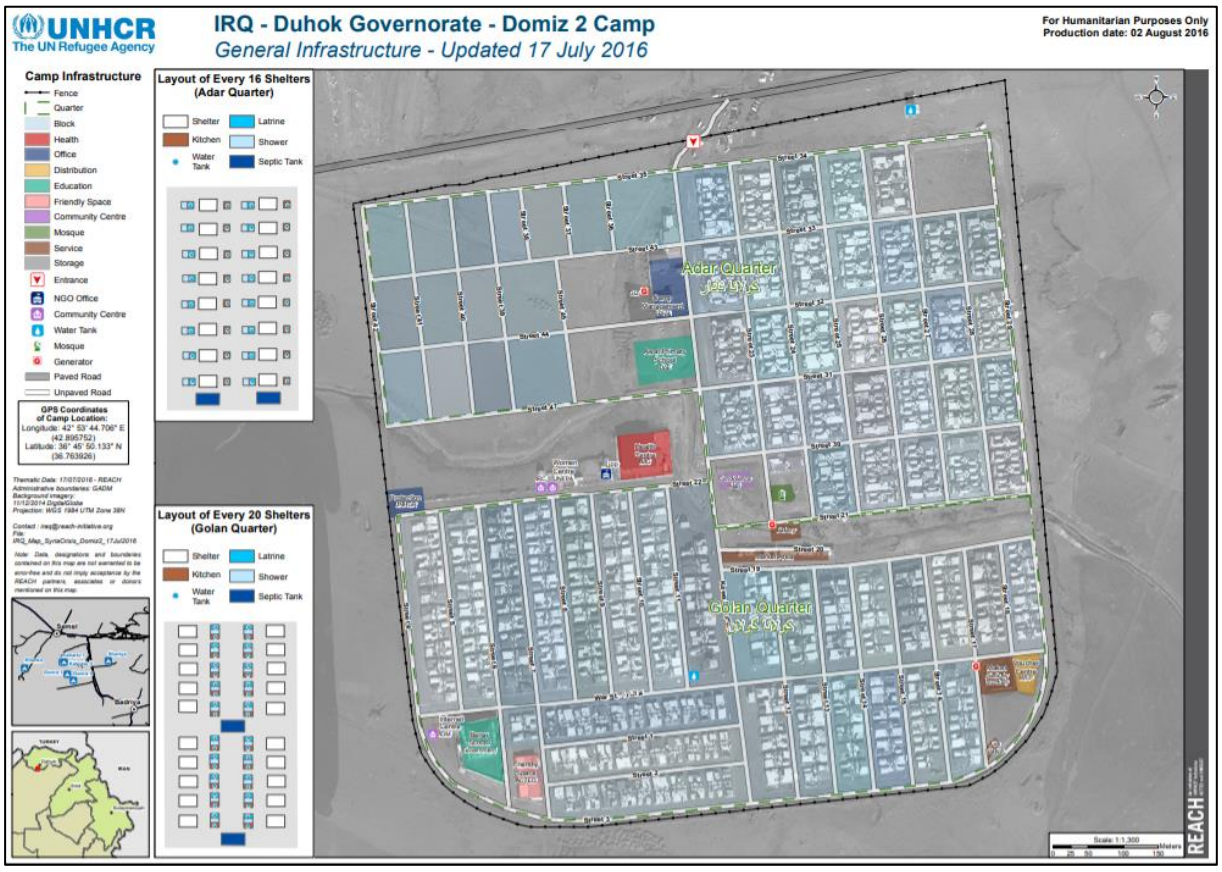

Figure 7: Domiz 2 camp layout plan. (Source: Reliefweb, 2019)

The camp was created 2km away from the Domiz 1 camp and Domiz Township in an area of land donated by the Government and which is outside of the area of future infrastructure master planning for the city. For the purposes of creating the SFD, the extents of the camp are clearly known and defined, and which is fenced in along the boundaries. The camp is quite densely populated for the space it occupies, owing to the smaller plot size for the shelter allocation.

The current registered population of the camp is 9,895 individuals, based on the camp profile from 25 June 2018 (There are several figures quoted from various sources, but for consistency in this report, the above referenced document will be taken as the source). This figure currently remains relatively static, other than the 3% annual population growth rate that has been observed by camp management. No significant population movements are known, such as for holidays. Visitors do attend the site though, but there is no reliable data on this.

Domiz 2 camp infrastructure development was carried out with funding from UNHCR and UNICEF in response to the continued influx of refugees from Syria, which started in 2012. Based on the inspections carried out by the author in 2019, the sanitation infrastructure installed is very basic in that it as household connections from toilets to holding tanks or septic tanks., The pipework goes from the shelter toilet to an inspection chamber on a collector line and from there a larger diameter pipe transfers the black water to the tank.

As detailed in the camp profile from 25 June 2018, some infrastructural improvements (Improving shelters and WASH facilities) have been carried out in the camp in the years since it was first established, as it has come to be realized that there is no immediate

indication of a return of the residents to Syria. According to UNHCR Duhok, the focus more recently, has been on reducing the ongoing operation and maintenance costs, particularly around sanitation, as the sanitation system is based on a short-term design life expectancy and is labour and cost intensive. From their surveys of the camp population about intentions to return to Syria or not, UNHCR Duhok staff have concluded that Domiz 2 camp is going to be in existence for the foreseeable future, with no immediate ability for the residents to return to their place of origin.

The current sanitation infrastructure in Domiz 2 camp generally comprises of grey water and black water being separated at household level, with black water going to either septic tanks or holding tanks (these are the locally used terms for these structures, but as will be shown later, in most cases they are in fact lined pits with semi-permeable walls and open bottom). Some of the liquid entering these tanks percolates into the ground through the floor and walls and from cracks or leaks in the septic tanks. Because the infiltration capacity of the soils is generally less than the loading applied from the soak pits, the septic tanks are desludged frequently, with the material taken to the outskirts of the camp and emptied into the natural drainage, atop a hill, about 2km to the north of the camp. However, dumping often happens closer to the camp, because the two trucks that are charged with all the desludging are struggling to keep up with the demand. Therefore, the drivers often use a wadi, nearby to the camp, to discharge the untreated waste into, which is the same process as in the official site, other than there is no “official” recognition of this site.

Grey water is directed from within to the households into the street drainage for collection in V-shaped channels, which also collect surface run off and then deliver this through increasingly larger channels into the natural drainage, which is part of the Mosul Dam catchment area. In most situations in KRI, including the host community, black water is considered to be toilet water only and grey water is all the other water outlets, including kitchen, washing, showers and laundry.

Figure 8: Domiz 2 Camp, showing 2017 expansion on left. (Source: UNHCR, 2018)

The Domiz 2 camp is laid out in 3 distinct residential sectors or quarters and within each quarter, the shelters are arranged in blocks. The black water connections generally consist of anywhere from 5 to 20 shelters per septic tank, though there are some exceptions. The septic tanks are arranged such that they collect waste from these blocks either through pipes connected directly from the household to the tank or through a basic collection system, with household connections joining a collector pipe through connection boxes (called manholes here). This collector pipe then connects into the tank.

2.1 Policy, legislation, and regulation

This camp was constructed under the UNHCR Codes for Shelter, WASH and CCCM. These various codes are available from the UNHCR website and are far too extensive to try to summarise here, other than to say that their intention is to provide minimum acceptable living standards to those who are defined as refugees during the emergency.

2.1.1 Policy

2.1.2 Institutional roles

The Government of the hosting country has the primary responsibilities for providing services to those fleeing the conflict in Syria. However, support of UN agencies and NGO's is brought in to assist where the hosting government identifies gaps and needs that it cannot meet. That has been the situation in KRI and, as previously mentioned, the hosting government established the BRHA to be the main agent in coordinating the response across the various sectors of health, WASH, Shelter and CCCM.

The humanitarian sector has provided expertise, guidance and in a lot of cases, financial assistance to deal with the burden on the hosting government. UNHCR and UNICEF, who

receive funding from global donors, provide funding to various directorates in order to manage the camps and to provide the essential services within the camps.

2.2 Planning

2.2.1 Service targets

The service targets that were used when the camp was established are those from the UNHCR Emergency Handbook, as well as the internationally known SPHERE guidelines. In this context, targets are introduced through the contracting, or partnering, arrangements between donors, UN agencies and NGO's or other service providers working on the ground. A quoted example from UNHCR staff in Duhok is that UNHCR receives funding from a donor for the construction of an improvement to the camp, including sanitation, then UNHCR will partner with an NGO, who will then oversee and engage the various contractors. In the agreement between UNHCR and the NGO, there will be various targets included, based on the relevant WASH standards, in relation to the sanitation improvement.

2.2.2 Investments

Funding for the initial emergency response came from the primary humanitarian funds, such as the Central Emergency Response Fund (CERF), various pooled funding among agencies. After the initial response a Humanitarian Response Plan (HRP) was formed and this targeted specific sectors, such as Shelter, WASH, etc. This then gave international donors the opportunity to put funding towards the various sectors, should they wish to do so.

More recently, individual donors, such as the "Kuwait Fund", have provided funding for the expansion of camp or the improvement in WASH/Shelter infrastructure. This has improved the living conditions within the camp by seeking to improve services.

2.3 Reducing inequity

2.3.1 Plans and measures to reduce inequity

Ongoing assessments by UNHCR and Peace Winds Japan NGO, such as KAP surveys (Knowledge Attitudes and Practices) seek to determine the level of service being provided for each of the shelters within the camp. Where issues such as inequity of water supply are reported, these are then included in the various planning and activities for humanitarian actors for the following year.

Currently these assessments are not indicating any inequity in relation to the operation of the sanitation system. One thing that was mentioned was the fact that the two households who live at the downstream end of the block of shelters connected to the containment system often can expand their shelter to encompass this extra area, and so end up with a larger plot in physical terms. However, this unauthorized expansion is not something that can be replicated and the households that do expand are advised that this may situation could be changed at any time in the future to suit the needs of the system improvements, etc. This was advised by the camp management team. On the other hand, some of these residents feel that the proximity to the containment system, which can often be odorous, is an inequity in its own right as they must put up with the odour from the system.

2.4 Outputs

2.4.1 Capacity to meet service needs, demands and targets

As with most emergency response situations, the Domiz 2 camp infrastructure struggles to cope with the demand and the peculiarities of the installation, for various reasons already mentioned. As a result, the continual improvement is strived towards where and when funding is available.

Unfortunately, one of the “self-defeating” aspects of being able to provide proper infrastructure in the camp is that there is no ability to collect operation and maintenance contributions from the residents. Therefore, the improvement of services is very much dependent on voluntary contributions from international donors. Perhaps in the future if this camp becomes an established community, then this can happen, but if it is under humanitarian management, it is unlikely that a tariff system will be used to improve services.

On the opposite side of the previous point is the fact that the longer that the camp is established, then the greater the expectations of the residents and authorities in terms of the quality of service to be provided. The residents themselves start to improve the look and feel of their shelters and immediate environments for a longer stay by creating gardens, building block walls, and painting or plastering the walls with themes from their home. The authorities allow these improvements as they don’t wish to see a significant group of population living in substandard conditions, as this will likely create various social and economic issues later.

2.4.2 Monitoring and reporting access to services

As mentioned, various surveys are the main methodology for collecting information for monitoring of services and these are annual, at best. But this is often a better service than that provided outside of the camp. The hosting community in the vicinity of the camp may not have much better services and what they do have, they must pay for.

2.5 Expansion

2.5.1 Stimulating demand for services

As the camp population grows and expands, there will be greater demand on the services that are in place. That is the main reason why the humanitarian response is trying to get services adequately supported while funding is available, as this may not be the case later.

2.5.2 Strengthening service provider roles

This is perhaps the key area that needs to be developed going forward, as currently services are managed by or through humanitarian contributions. At some point when this funding runs out, it will be important that those in the community are able to deal with this or at least be able to support local municipalities in providing these services.

Since 2019 there has been more progress on this as UNICEF have started targeting their funding directly to the municipalities in order to encourage them to develop the systems and staffing levels that are needed to maintain these systems. Similarly, UNHCR has provided funding for camp management and coordination at the local level.

3 Service Outcomes

Domiz 2 camp was constructed after Domiz 1 and with more time available and therefore the sanitation system that has been constructed is more homogenous and consistent throughout the camp and is built in consideration of the lessons learnt out of Domiz 1. In particular, an attempt was made to use all septic tanks with soak pits so that the amount of desludging would be reduced. The main containment type is septic tank, but in this there are two types of construction that will be detailed later in the containment section.

3.1 Sanitation Chain Overview

3.1.1 Capture/Collection

Collection of faecal waste is via a squat toilet, which is based on the principle of using water to flush the toilet contents and providing a water seal to prevent odour from the containment system returning to the building. This collection system collects faeces, urine, water for anal cleansing and flush water, which collectively are called blackwater. Because of the layout of the camp in blocks of from 5 up to 20 shelters, the containment system is located at the downhill end of the block and the faecal waste collection system consists of a small diameter pipe that connects the household toilet to a bigger, collector pipe that then transports the waste to either a septic tank or lined pit, which is the containment system, as shown in figure 9.

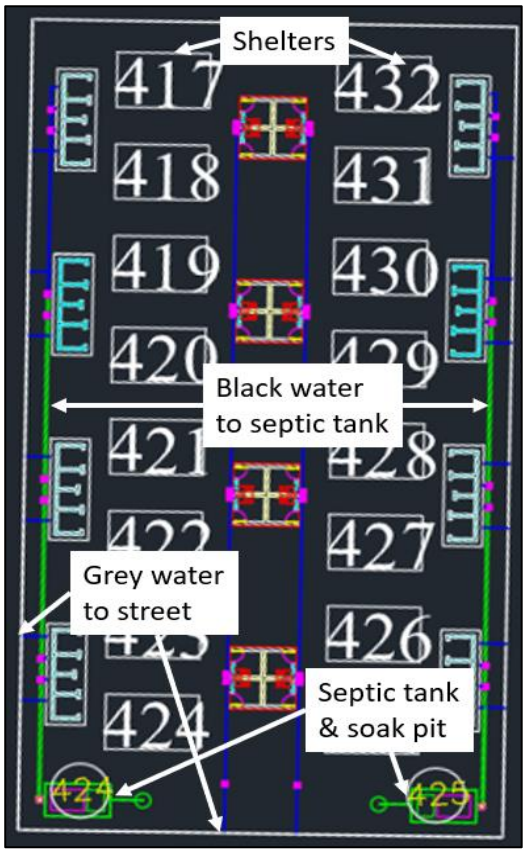

Figure 9: Domiz 2 drainage layout, Harem Quarter. (Source: UNHCR, 2019)

The waste from kitchens, showers, wash hand basins and baths, called greywater, are directed into a separate system of channels, as per figure 9, that removes this material from the camp through the natural irrigation system to the outside of the camp.

No open defection occurs in the camp, according to the camp managers, as the capture/collection systems are at household level. This wasn't always the case and when there were communal toilets systems, there was open defecation happening in the camp.

3.1.2 Containment

As previously mentioned, grey and blackwater are separated at the shelter plots, with grey water going to open channels for surface water drainage and the blackwater goes to a containment structure. In some instances, based on the assessment carried out, it is clear that the black and greywater is mixed at the household level and this wastewater then goes to the containment system. An example is washing machines discharging to the toilet.

The containment systems are generally referred to as septic tanks, with soak pits. In the Golan quarter, according to the desludging assessment, most of the tanks do not have soak pits. Upon more detailed inspection in the sanitation assessment, it has been established by the author that these are more properly described as lined pits with semi permeable walls and open bottom, based on the SFD Users Guide. The details and sizes of the various tanks in the quarters is included in table 2, below.

Table 2: Details & distribution of containment systems. (Source: Author, 2019)

Quarter	Volume of Containment System				Total No	With Soak Pit	Without Soak pit
	$12m^3$	$15m^3$	$17m^3$	$18m^3$			
Adar		4	71	10	85	85	
Golan	10	46			56	1	56
Harem		62			62	62	

From table 2 it can be seen that there are two types of containment system:

1. Septic Tank and Soak Pit – At the time of writing there were 147 of these in Domiz 2 camp, comprising 72% of the total amount of containment systems (203). These range in size from $15m^3$ (66 no.), $17m^3$ (71 no.) or $18m^3$ (10 no.). They are constructed from blockwork and plastered on the inside, thereby providing an internal seal. There is a partition wall in the tank that separates it into the primary and secondary chambers, with the ratio being 2:1. These tanks are believed to have a concrete base slab, though it was not possible to confirm this in the assessment. The have an outlet pipe installed slightly lower than the inlet and takes the “treated” liquid through to the soak pit where it can infiltrate through the walls of the pit into the surrounding ground. On many of the inspected tanks the outlet tee was either installed incorrectly or not installed at all, leading to solids and suspended particles passing through to the soak pit and the surrounding ground.

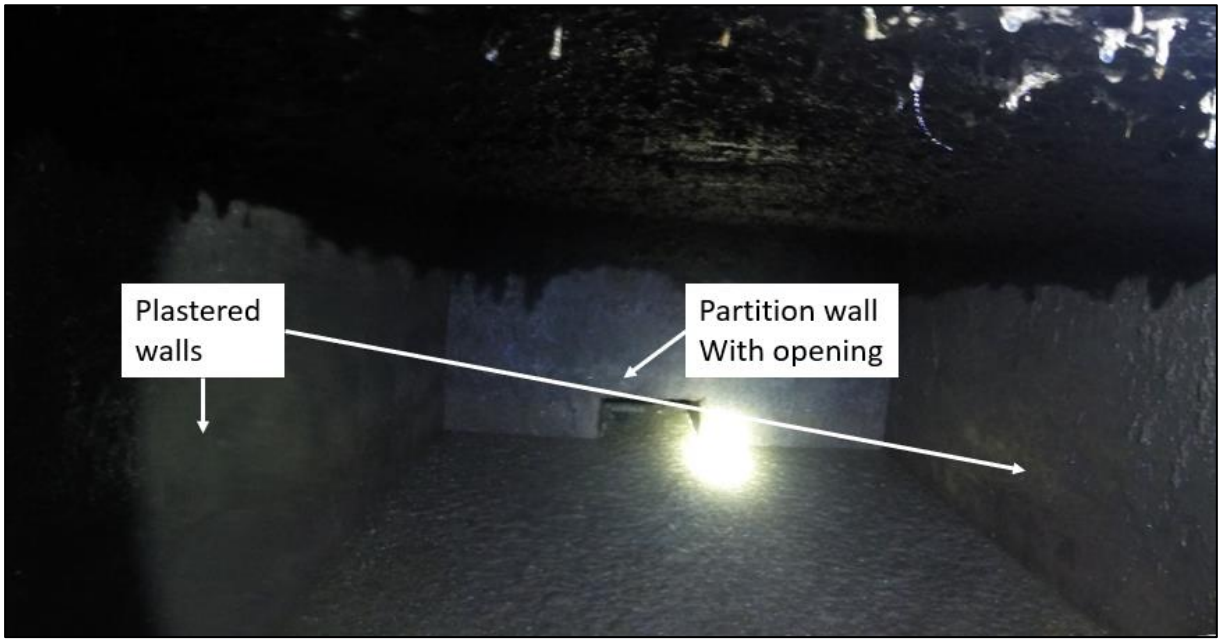

Figure 10: Septic tank internal picture, 65 Adar Quarter (Source: Author 2019)

Based on the desludging assessment, most of these tanks are being desludged up to twice a month on average.

2. Lined pit with no outlet and semi-permeable walls – These are also referred to as septic tanks locally, and do include a partition wall, though this does not go to the top water level. At the time of writing there were 56 of these in Domiz 2 camp, all in the Golan quarter, comprising 28% of the total amount of containment systems (203). They are either 12m^3 (10 no.) or 15m^3 (46 no.) total volume. These are locally called septic tanks, because they do have a partition wall of sorts installed, but they differ fundamentally because they are not lined properly, the partition wall does not rise to the topwater level, and they don't have a soak pit connection for the treated effluent. Because of this, they are more accurately described as a lined pit with semi-permeable walls and no base. It was not able to be determined during the assessment if there was a base installed, but the camp management staff felt that this was unlikely because of the type of construction. The intention of this containment system is to let as much liquid as possible infiltrate into the ground, through the permeable walls and the open bottom. The system requires regular desludging, between two and four times per month, as with up to twenty households connected to it, there is more liquid being added than what usually can infiltrate into the ground, particularly where grey and blackwater are mixed. This infiltration reduces the amount of desludging that must happen, thereby minimising the cost, but that does create a potential risk for groundwater.

Figure 11: Lined pit with impermeable walls and open base, called a "holding tank" locally. (Source: Author, 2019)

As a result of the black and grey water being put to ground, the risk of contamination of groundwater has always been significant and in testing of the water supply in nearby Domiz 1 camp in 2017 it was found that the water had high levels of Nitrogen and Faecal Coliforms present, indicating that the water is not fit for drinking. Therefore, the belief from the Water Directorate is that the same risk applies in all the camps in the area, including Domiz 2.

3.1.3 Emptying

This is carried out by two 10,000l vacuum trucks, provided by UNHCR in 2017, according to UNHCR Duhok staff in 2019. This same type of trucks can also be provided by private contractors, where needed, for extra capacity or to cover breakdown of the dedicated trucks according to the camp management staff. These staff monitor the various containment systems within the camp and direct the desludging service to the various locations when it is required to prevent overflow. Their knowledge of when the systems need to be desludged is gained through firsthand experience of walking around the camps or from calls from residents who live beside the containment systems and see that they are full.

The vacuum trucks have a flexible suction hose that is inserted into the containment pit to vacuum the FS out. There is difficulty in completely emptying the pit, owing to the narrow opening in the roof slab and the flexible hose, which often results in solids being left in the corners of the pit, away from the opening in the roof slab. For any of the tanks that are larger than 8.5m^3, they are not fully emptied each time as the drivers only remove the volume of the truck from each of the containment systems, as mentioned in the assessment. Generally, the tank volume in Domiz 2 is between 12 and 17m^3.

UNHCR, through Peace Winds Japan NGO carry out a camp KAP survey annually and gauge the camp resident's satisfaction with the various services provided and in general there is satisfaction with the emptying of the containment systems, though people do comment that in winter some overflow, and cause odour nuisance.

3.1.4 Transportation

The same vehicles that are used for emptying the onsite containment systems are also used for transporting the FS to either the treatment or discharge sites. There are currently two desludging trucks working in Domiz 2 and they operate seven days a week for approximately eight hours a day. These trucks work constantly to keep up with the demand during the summer. According to the camp management team, in wintertime, the trucks are almost always behind in terms of keeping the tanks emptied as required, most probably related to inflow and infiltration of surface and ground water into the tanks.

The operational times are restricted to eight hours because there are many tanks within shelter boundaries and BRHA try to avoid disturbing people as much as possible. If one of the trucks breaks down, this then puts pressure on the other to take up the extra demand.

3.1.5 Treatment

At the time of this SFD being compiled, there was no treatment occurring on any of the material being desludged, it was being taken to a designated dumping location. However, in 2019 GIZ funded the design and construction of a wastewater treatment plant (WWTP) near Domiz 2 camp, and this was close to being finished construction at the time of writing. The treatment process is Waste Stabilisation Ponds (WSP), which is a passive system, using a series of ponds, as indicated in figure 9 below, to do the treatment.

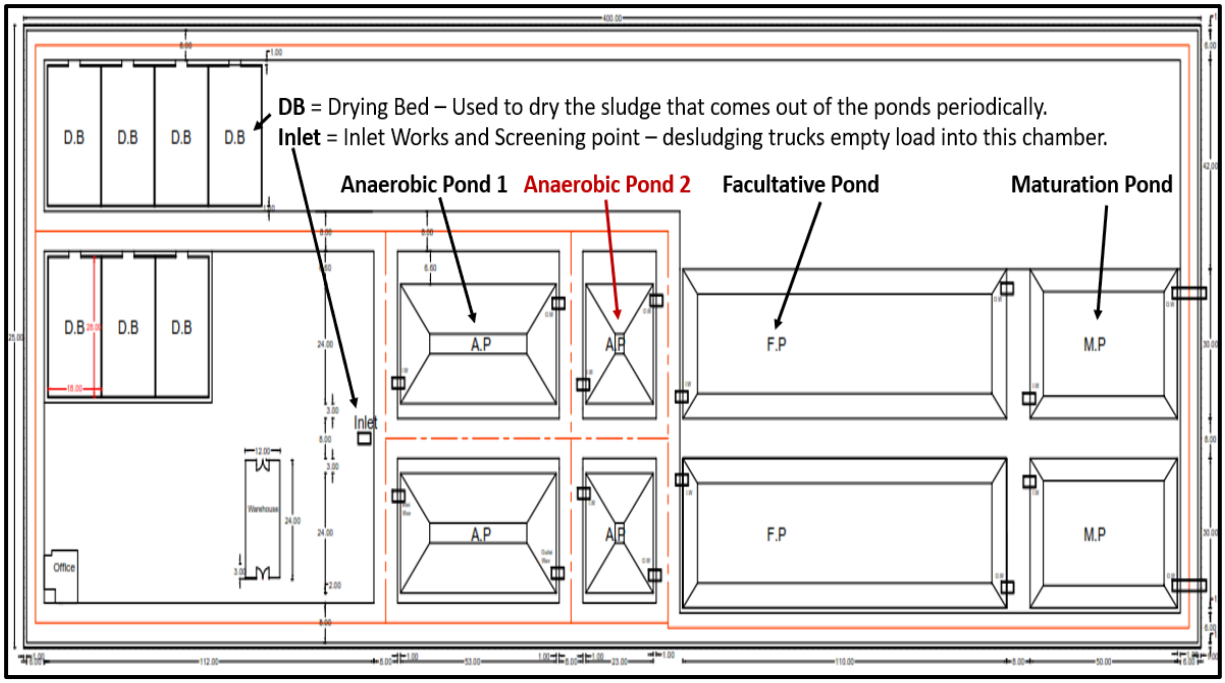

Figure 12: Waste Stabilisation Ponds Layout (Source: Dr Nashwan Shawkat)

The following description on the system is based on the operational plant in 2021, but the SFD diagram has not been amended, as no treatment was occurring at the time of the original writing. The plant was commissioned and began operating in January 2020.

Treatment is carried out as the faecal sludge travels through the series of ponds, starting with initial screening, to remove any large solids. The first ponds are anaerobic, followed by a facultative and maturation pond, that are aerobic in nature. The sludge that settles out in the anaerobic ponds is removed by pump to the drying beds when the sludge level in the ponds builds up past an established operational point and starts to impede the treatment capacity, through diminished treatment time.

Apart from the sludge pumps, the process is entirely passive (not requiring mechanical or electrical assistance), with the flow moving through the ponds, receiving treatment at each stage and the final effluent is then discharged into a wadi beside the pond's location. It is intended that at some point, when the treated effluent is at an acceptable level, the final effluent can be used for irrigation in the surrounding area. This would add a final stage of treatment, where the nutrients in the treated effluent would be taken up by the soil and plants and therefore using them beneficially.

3.1.6 Disposal/Reuse

As mentioned, the greywater disposal is to the wadi and on through the natural drainage, which eventually drains into the Mosul Dam. The blackwater is being discharged to a designated dumping location, which also flows into the natural drainage channels towards the dam.

Because the blackwater in the containment system does not stay for very long and thicken over time, it was previously described to the author by local UNHCR Duhok staff that this material was not liked by farmers for spreading on the land as it did not have the same qualities as material that thickens and breaks down over time in the pits, which reportedly provides a better fertiliser. This information was advised during the 2019 assessment in Domiz 1 and was confirmed camp management team during discussions in the field.

3.2 Containment System Assessment

An assessment of the containment systems was carried out in Domiz 2, and this mirrored the one that was done in Domiz 1, just over a shorter timeframe. The timeframe was the beginning of May through to mid July 2019. This included the period of Ramadan for that year, which allowed an observation of the habits and flows over this period to see if there was any discernable difference between that period and the rest of the year. Holidays and religious festivals often provide peaks in flows and different timings on the peaks also.

The assessment had three main components: -

- Physical inspection of the selected tanks. This involved the following: -
  - Review of the desludging assessment to determine the frequency of the desludging compared with the number of users. As this desludging assessment was not recently updated, discussions were held with the WASH staff on the ground to determine the tanks to assess.
  - Emptying of the tank with a desludging truck and inspection of the internal structure of the tank using a camera and artificial lighting to observe structure condition and any evidence of leakage, in or out of the tank.
  - Inspection of how the nearest households interact with the tank. For example, how close are the shelter walls to the edge of the tank, has access to the tank been restricted, etc.
- Inspection of the tank lid and surrounding ground to see how surface water interacts with the tank.
- Wastewater level monitoring in tanks. Level/temperature monitors were installed in some of the tanks that were inspected. These sensors measure the rise in level over time and the corresponding temperature of the black water in the tank over time. Having physically measured the internal area of each tank, it was possible to determine the flow rate into the tank based on the level increase.

3.2.1 Selection of Assessment Locations

The desludging assessment for Domiz 2 was used as the basis for the sanitation assessment and was the reference tool for selecting the tanks to be inspected. This process covered all the quarters in the camp, though not all the septic tanks were represented in the assessment, so on site discussions with the operators, camp management staff and desludging truck drivers, were needed to determine which tanks to be inspected.

3.2.2 Assessment Findings on Containment Systems

The detailed field assessments started in early May 2019 and continued through to mid-July. Where possible, BRHA technical staff were involved in the assessments, to keep them aware of the findings, however this wasn't always possible. All information that was collected during the assessments has been shared with the technical staff in Domiz 2.

For ease of reference these findings can be summarized as follows, using the sanitation cervices chain format:

Capture/collection

1. Trees planted beside the containment system or pipework are going to be a major problem in a few years when the roots start to seek out the water in the tanks. As they grow and get bigger, they are going to cause problems on the tanks constructed from blocks, as roots will easily penetrate these.
2. Most "manholes" that have been observed are very poorly constructed, with no smooth transition from pipe to chamber to pipe. They have edges and square chambers that collect solids and will potentially lead to blockages.
3. In a lot of cases there is no obvious indication of these manholes on the ground, as they have been covered by surrounding shelters. In some cases, the covers are concreted over completely, or planted on in gardens.

Containment

1. Almost of all the containment systems observed have had some form of shelter development near, or over them. This varies in form from gardens planted on top of the tank lid, to shelter expansion and walls being built over them to the tank cover being used as part of the shelter open area.
2. A lot of the containment systems have had the vents removed.
3. Some issues related specifically to the newer septic tanks that have been observed are as follows: -
    a. The openings in the baffle wall generally are in the middle, it would create better hydraulic movement in the tank if there were two small openings, set to each side, rather than the middle.
    b. Many septic tanks have no inlet or outlet tees. These are essential for the proper functioning of the tank and must meet the minimum standards for extending below the top water level of the tank.
    c. Many of the tanks which do have inlet and outlet tees in place, have these oriented in a horizontal, rather than a vertical direction. This allows the solids to enter from either side and again pass to the soak pit.

4. Where soak pits have been installed, they are mostly covered with materials, owing to them not being inspected. Coverings vary from garden soil to water tanks, which have been observed.
5. Based on the level sensor readings it appears that there is water entering the tanks from several sources. While it is hard to determine these exactly, by comparing temperature readings in the containment systems at the same time as the increased level, there are a few likely possibilities: -
    a. Overflow of potable water from the roof storage tanks, perhaps due to faulty, or lack of ball valves.
    b. Water ingress to the tank from the surface around the covers. Rainfall and cleaning of the ground over and around the tank could enter from this location. In almost all the tanks that have been subsumed into shelters.
    c. Corresponding increase in level and decrease in temperature corresponding to known rain events indicate that the systems installed are prone to surface water inflow/infiltration. Based on feedback from the camp management technical staff, this is an issue in most tanks.
    d. Grey water entering the system from individual household can be observed by comparing sudden increase in level and temperature around the same time.

Emptying

1. Many of the desludging pipe openings used to access the containment systems are broken off at ground level. Some of these have caps in place, but others have a concrete cover placed over. These pipes are entry points for surface water to the tanks and will likely be adding flow in rainy periods, or when washing of the ground is happening in the vicinity.
2. The large septic tanks should have 3 openings of minimum 400mm x 400mm. One over the inlet and outlet tee, to provide access there and one over the baffle wall. Owing to the large size of the tanks combined with restricted access to openings, it is only possible for the desludger to empty directly below the opening. Hence solids that accumulate on either side of the baffle wall are not removed. This will result in solid material building up over time and reducing the working volume of the tank.

3.2.3 Estimating the flow per person from level data.

For estimating the flow per person, the information from the inspections in the Domiz 1 camp will be used, as this has been thoroughly investigated and reported on. The assessment findings in Domiz 2 indicate that there is a higher level of black water being produced but based on discussions with the camp management staff and desludging truck drivers, this is considered to be from the addition of grey or potable water to the system, rather than actual black water amounts being increased.

The design flows to be used are as follows: -

- Water consumption per capita - 120/p/d
- Black water per capita – 20 - 25l/p/d
- Grey water per capita – 65l - 70/p/d

3.3 SFD Matrix

The method of dealing with black water in the Domiz 2 camp is via septic tanks, with soak pits that allow some liquid to permeate into the soil around and below the tank, but then must be emptied on a regular basis, and also in lined pits with semi permeable walls and open bottom. The desludged material dumped in the open about 2km from the camp.

The main operational points of this system are as follows: -

- The sanitation assessment indicates that approximately one third of the liquid that enters the tanks is lost through leakage from the tanks. This is the 30% that is represented as not contained, when shown in the SFD. Every tank measured was leaking and in Domiz 2, they are all leaking at a reasonably similar rate.
- Grey water is collected in channels outside each household and transported under gravity to the natural drainage system, where some evaporates, some soaks into the ground and the balance flows through the drainage.
- Where newer septic tanks and soak pits have been constructed, it has been established that the tanks are also leaking up to one third of the liquid that enters, as they are built with blocks, rather than concrete.
- Soak pits are generally not working effectively, and many septic tanks are now working as holding tanks primarily, having to be desludged on a regular basis.

Table 3: Domiz 2 camp SFD Matrix. (Source: Author, 2019)

Domiz 2 Syrian Refugee Camp, Kurdistan, Iraq, 24 Jul 2019. SFD Level: 3 - Comprehensive
Population: 9895
Proportion of tanks: septic tanks: 50%, fully lined tanks: 100%, lined, open bottom tanks: 70

Containment				
System type	Population	FS emptying	FS transport	FS treatment
	Pop	F3	F4	F5
System label and description	Proportion of population using this type of system (p)	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
T2A2C5 Septic tank connected to soak pit, where there is a 'significant risk' of groundwater pollution	72.0	100.0	100.0	0.0
T2A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	28.0	100.0	100.0	0.0

Proportion of the population that use this type of system: - As summarised from the containment section.

- Septic tanks: –
  - 72% of the camp population use this type of containment system, based on the sanitation assessment and discussions with the camp management team and desludging truck drivers.
- Lined pits with semipermeable walls and open bottoms: -
  - 28% of camp population use this type of system, based on the same factors as above.

Proportion of the tank volume that is emptied: -

- From the sanitation assessment carried out it has been identified that the tank structures are losing up to 30% of the incoming flow through leakage and subsequent infiltration to the ground. Therefore, for both systems we will assume the following: -
  - Septic tanks: –
    - 30% of incoming flow leaks through the tank structure, as above.
    - Assume that another 20% of the liquid is infiltrated to the ground from the soak pit. This assumption is based on discussions with the camp management staff and desludging truck drivers and their experience in terms of the frequency of desludging from each tank.
    - Total amount of liquid infiltrated to the ground is 50%, therefore the other 50% is emptied and considered to be faecal sludge.
  - Lined pits with semipermeable walls and open bottoms: -
    - 30% of incoming flow leaks through the tank structure, as above.
    - There is no soak pit, so no further infiltration occurs, therefore 70% of the incoming volume is emptied and considered to be faecal sludge.
- The assessment also indicates that there is grey water getting into some of these systems, but it has not been possible to determine with any degree of certainty what percentage of the overall tanks are affected and what the increased volume is. Therefore, it is not going to be accounted for in terms of differentiating materials.

Proportion of this type of system from which FS is emptied: -

- Septic tanks: –
  - It's estimated that 100% of the septic tanks have material removed from them on a regular basis but based on the desludging assessment and stakeholder input. These tanks are emptied up to twice a month.
- Lined pits with semipermeable walls and open bottoms: -
  - 100% of these pits are emptied, as they don't have enough infiltration happening through the leakage to avoid regular emptying. Most are emptied up to four times a month.

Proportion of FS emptied which is delivered to treatment plants: -

- For both containment systems, none of the emptied material is being delivered to a treatment plant. The emptied material is transported to a dedicated disposal site, as determined by the Directorate of Municipalities. Transportation of the faecal sludge is not a problem in this camp, as there are enough vehicles currently allocated.
- To highlight that transportation is not a problem in the camp, it has been given 100%, even though it is not going to a treatment plant. The material is being taken to a dedicated dumping site and so it is controlled, to an extent. The use of 100% is used for consistency with the other SFDs produced in this area, as part of this exercise.

Proportion of FS delivered to treatment plants, which is treated: -

- For both containment systems none of the emptied material is being delivered to a treatment plant. At the time of writing the material is being removed to a dedicated dumping site. Therefore, the figure used here is 0%.

4 Stakeholder Engagement

The preliminary stakeholder engagement was through direct meetings with the various directorates and other stakeholders to the Domiz 2 camp.

Once the assessment had been carried out and there were findings to be discussed, this was done with the camp technical staff to ensure the accuracy of what is being reported as well as to ensure the interpretations concur with the staff who work there every day and know and understand the situation better than anyone.

5 Acknowledgements

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To all the various stakeholders who participated in the assessments, workshops, discussions and casual fact-finding meetings, a great debt of gratitude is owed, as they gave their time unreservedly.

Thanks to NaSa colleagues who provided review and comment on the original submission.

6 References

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UNHCR WASH Manual – Practical Guidance for Refugee Settings

UNHCR Emergency Shelter Standard

UNHCR Emergency Handbook Camp Coordination and Camp Management (CCCM)

7 Appendix

7.1 Appendix 1: Stakeholder Identification

Table 4: Stakeholder identification. (Source: Author, 2019)

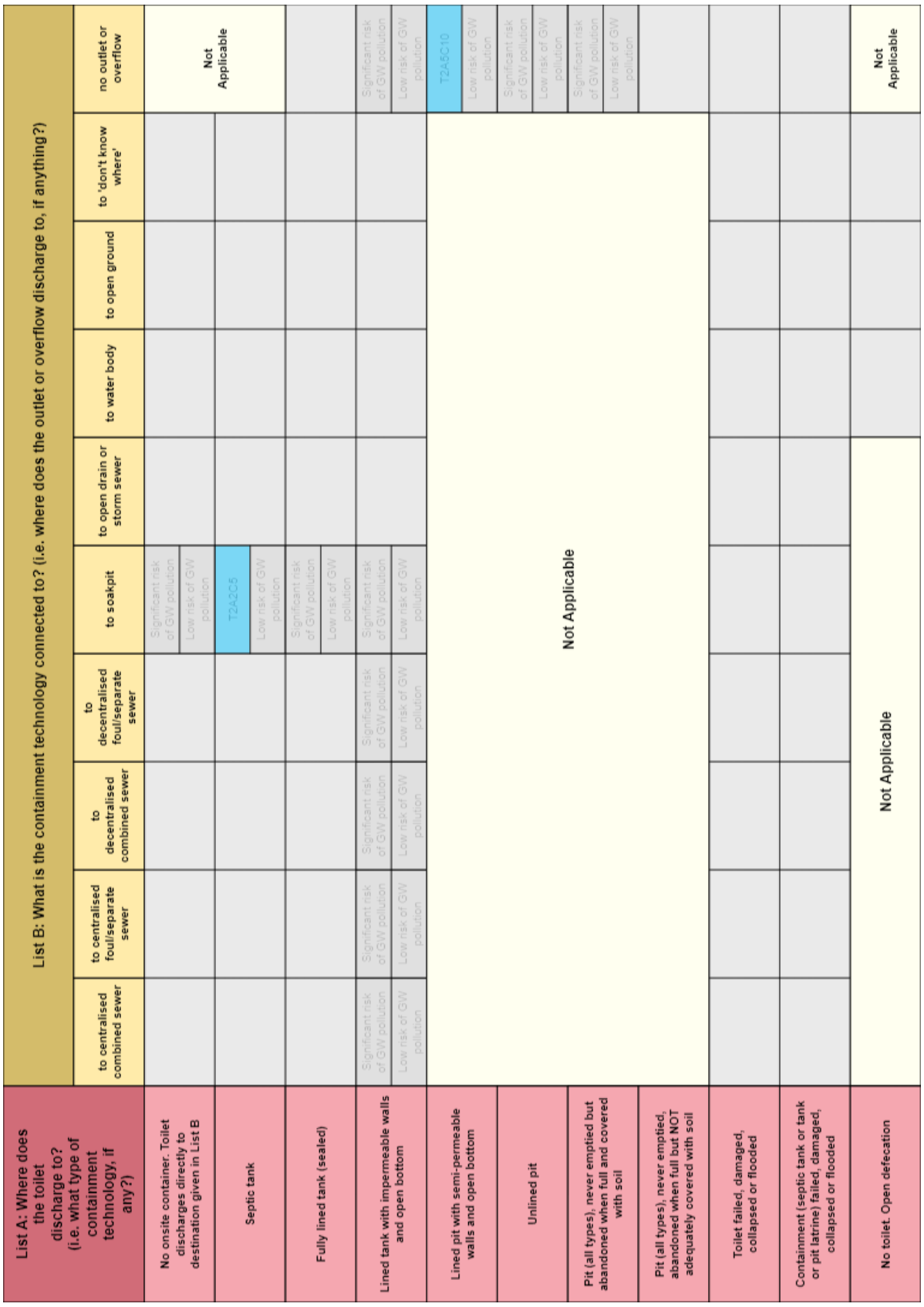
No.	Stakeholder Group	In Duhok Context	Roles
1	Government Departments	Directorate of Sewerage Directorate of Water Outskirts Directorate of Municipalities Directorate of the Environment	Provide information on sewage master plan. Provide information used estimating the volume of water used. Provide information on the waste management. Provide information on the testing of the water.
2	UN	UNHCR UNICEF	Provide information on the camp management. Provide information on the services management and camp establishment.
3	NGO	ACTED Peace Winds Japan	Provide information on the construction of the WSP. Provide information on the KAP surveys.

7.2 Appendix 2: Tracking of Engagement

Table 5: Tracking Stakeholder Engagement Table. (Source: Author, 2019)

Name of Organisation	Contact Person	Designation	Date of engagement	Purpose of engagement
Directorate of Sewerage	Mr. Sinan Shaba	Engineer	10 June 2018	Introductions, background to the project and interview.
Directorate of Municipalities	Mr. Haval Mr. Sherzad	Director Engineer	10 June 2018	Introductions, background to the project and interview.
Directorate of Water Outskirts	Mr. Dindar Mr. Vagar	Director Engineer	11 June 2018	Introductions, background to the project and interview.
BRHA	Mr. Assad	Engineer	11 June 2018	Introductions, background to the project and interview.
Directorate of the Environment	Mr. Hassan	Engineer	12 June 2018	Introductions, background to the project and interview.
UNHCR	Various technical	Engineers	May through July 2019	Presentation of options and agreement on basic information and findings.
Domiz 2 Camp Management Technical Staff	Various technical	Technical Staff	23 July 2019	Presentation of options and agreement on basic information and findings

7.3 Appendix 3: SFD Selection Grid



7.4 Appendix 4: SFD Matrix

Domiz 2 Syrian Refugee Camp, Kurdistan, Iraq, 24 Jul 2019. SFD Level: 3 - Comprehensive
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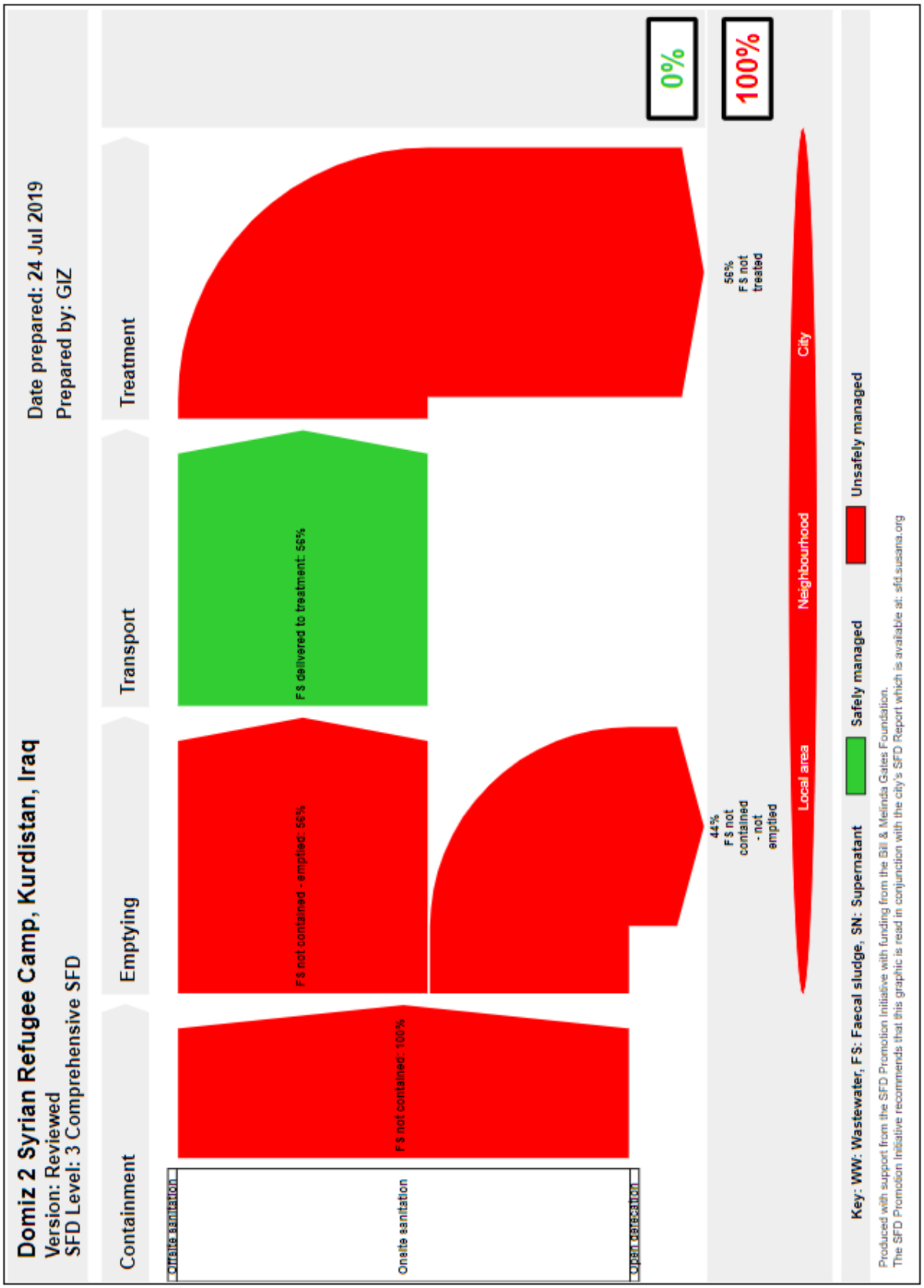
7.5 Appendix 5: SFD graphic



SFD Domiz 2 Syrian Refugee Camp, Kurdistan Region of Iraq, 2019

Produced by:

GIZ (Martin O' Malley, who was deployed to UNHCR Duhok by RedR Australia, under funding from GIZ)

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