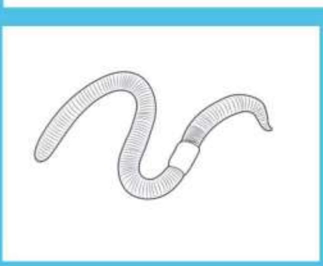
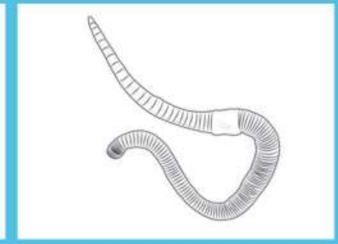
TIGER WORM TOILET MANUAL

Globally relevant learnings from Myanmar





OXFAM

TIGER WORM TOILET MANUAL

Globally relevant learnings from Myanmar

October 2018

Oxfam's Tiger Worm Toilet project in Myanmar is supported by Elrha's Humanitarian Innovation Fund, a grant making facility supporting organisations and individuals to identify, nurture and share innovative and scalable solutions to the most pressing challenges facing effective humanitarian assistance.

The Humanitarian Innovation Fund is funded by aid from the UK Government.

Visit www.elrha.org for more information about Elrha's work to improve humanitarian outcomes through research, innovation, and partnership.

This manual is intended to be printed and read as a colour double sided booklet.

CONTENTS

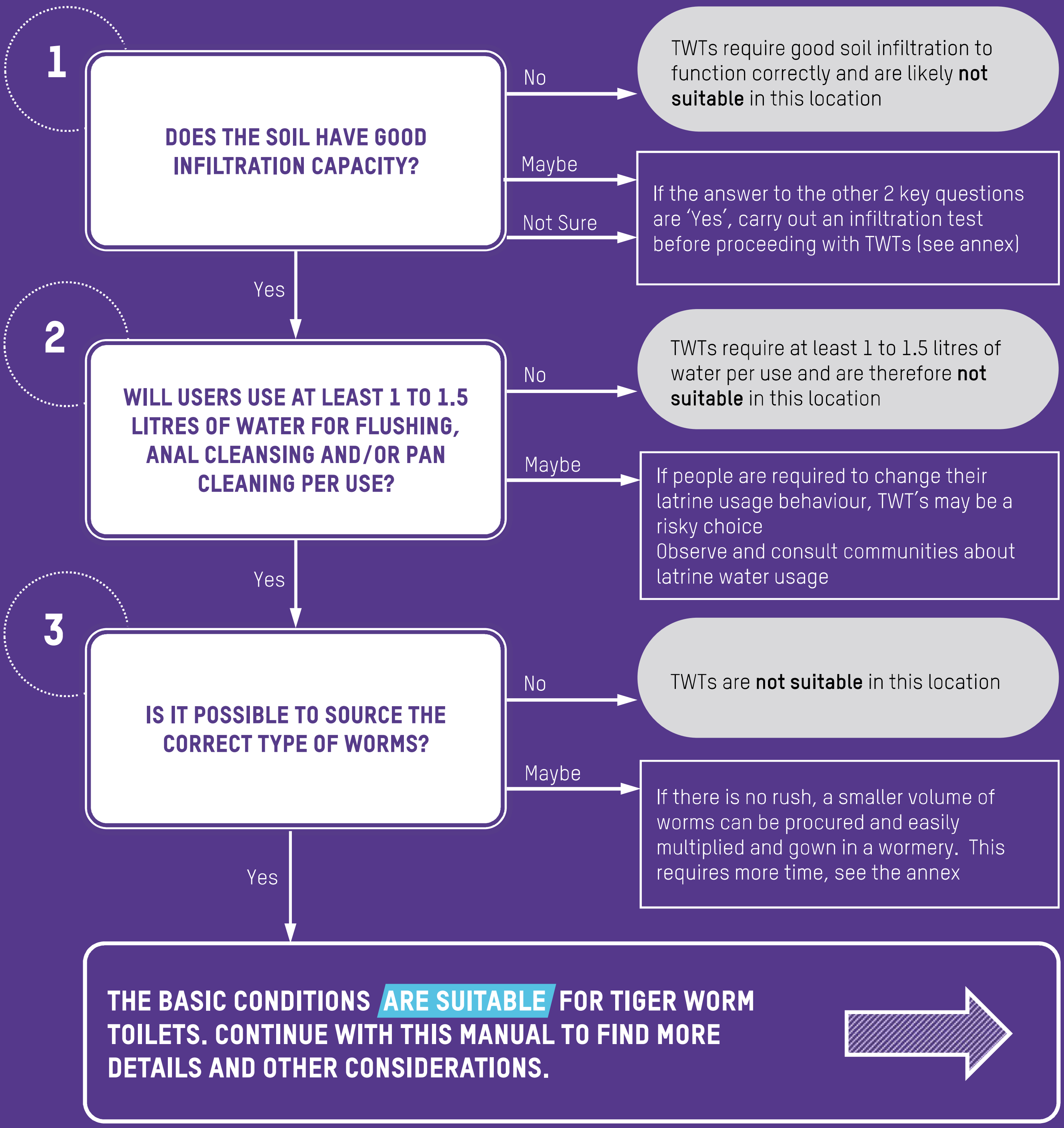
TWT

TIGER WORM TOILET

DECISION TREE

Before continuing, there are some key factors to consider if tiger worm toilets are suitable for your location:

KEY QUESTIONS



1

DOES THE SOIL HAVE GOOD INFILTRATION CAPACITY?

No

TWTs require good soil infiltration to function correctly and are likely **not suitable** in this location

Maybe

Not Sure

If the answer to the other 2 key questions are 'Yes', carry out an infiltration test before proceeding with TWTs (see annex)

Yes

2

WILL USERS USE AT LEAST 1 TO 1.5 LITRES OF WATER FOR FLUSHING, ANAL CLEANSING AND/OR PAN CLEANING PER USE?

No

TWTs require at least 1 to 1.5 litres of water per use and are therefore **not suitable** in this location

Maybe

If people are required to change their latrine usage behaviour, TWT's may be a risky choice
Observe and consult communities about latrine water usage

Yes

3

IS IT POSSIBLE TO SOURCE THE CORRECT TYPE OF WORMS?

No

TWTs are **not suitable** in this location

Maybe

If there is no rush, a smaller volume of worms can be procured and easily multiplied and gown in a wormery. This requires more time, see the annex

Yes

THE BASIC CONDITIONS ARE SUITABLE FOR TIGER WORM TOILETS. CONTINUE WITH THIS MANUAL TO FIND MORE DETAILS AND OTHER CONSIDERATIONS.

WHAT IS A TIGER WORM TOILET?

Tiger Worm Toilets (TWTs), sometimes known as Tiger Toilets or vermifilter toilets, contain composting worms inside the pit that process and digest the faeces in-situ, replacing the build-up of raw sludge with vermicompost. This removes the need for traditional desludging, as the vermicompost is simpler to remove and builds up at a slower rate. This can lead to a reduction of the long-term operating costs and removes the need for expensive desludging and sludge treatment infrastructure. A worm colony can live inside the toilet indefinitely so long as the correct environmental conditions are maintained.

OXFAM

Trials from 2013 onwards were run by Oxfam. Other trials have been run by other organisations.

2009

The Bill & Melinda Gates Foundation awarded a grant to the London School of Hygiene & Tropical Medicine to help find innovative solutions to the problem of pit latrine filling. The TWT emerged as the lead innovation.

2011

Proof of concept

Laboratory trials successfully run

Wales: Centre for Appropriate Technology

2012

Pilot TWT successfully run

2013

1st Field Trial

Ethiopia: Dire Dawa
10 TWT
up to 10 ppl
Pour-flush
Urban setting
⚠ Lack of water was an issue

Liberia: Monrovia, Dolo Town & Buchanan
583
5- 10 ppl
Pour-flush
Urban & peri-urban setting

2014

Myanmar: Kachin
10 TWT
5-7 ppl
Offset direct drop
Camp setting
⚠ Worm availability and cost challenges.

WHY MAKE THIS MANUAL?

To date, over 900 TWT's have been built and trialled across four countries by Oxfam in a range of settings including urban, peri-urban and camps. Trials have also been run by other organisations as well as installations by the private sector. They have been proven to work in both household and shared communal camp settings. However, the learnings show that TWTs are not the solution to all sanitation problems. This manual aims to present considerations for TWTs and provide a guidance for implementation based on globally relevant learnings from Myanmar.

2016

Sierra Leone
54 TWT
6-10 ppl
Pour-flush
Urban setting

2017

Direct drop successfully trialled

Ethiopia: Gambella
88 TWT
5-7 ppl
Direct Drop Pour Flush (SATO or modified U-bend)
Camp setting
⚠ Worm availability challenges

Sierra Leone: Kabala Town
200 TWT planned
5 ppl & 15 ppl
Offset pour-flush
Peri-urban setting

2018

Myanmar: Rakhine
45 TWT
5 ppl
Offset direct drop 'pour flush'
Displaced household setting

34 TWT
20 ppl (5 families)
Offset direct drop 'pour flush'
Direct drop 'pour flush'
Camp setting
⚠ Worm availability challenges

1st successful trial of communal shared TWTs

Furlong, C *et al*. 2017

KEY FEATURES

LESS FREQUENT EMPTYING

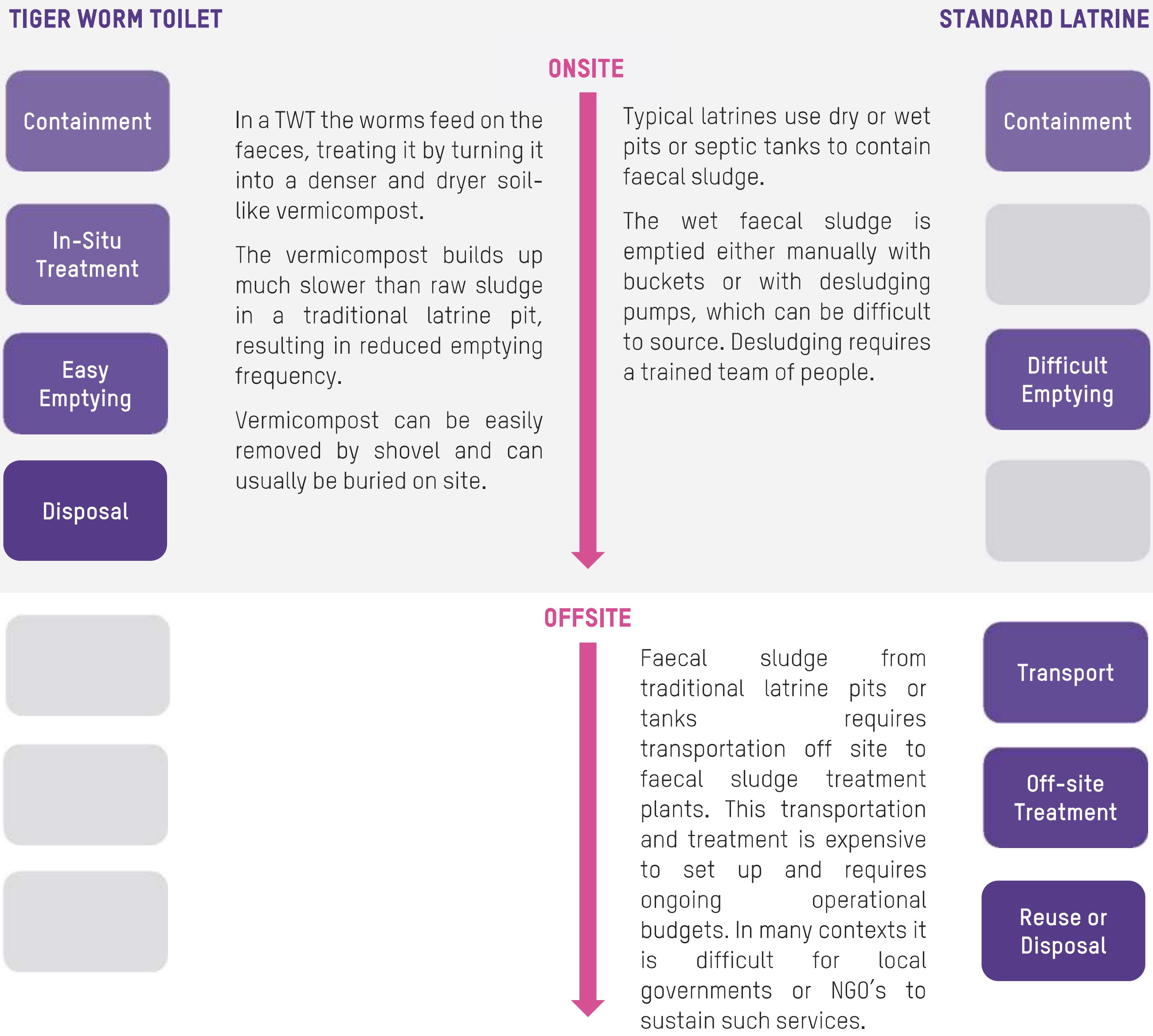
The worms process the faeces into a denser and dryer vermicompost, meaning that TWTs typically only require emptying every 3-5 years. Emptying is also easier as the vermicompost is at the top and can be emptied with a spade.

LOWER COSTS

TWTs typically cost a similar amount to a typical latrine for materials and construction. However, due to less frequent emptying, not requiring traditional desludging and sludge treatment infrastructure, the overall lifecycle cost can be much lower.

LESS SMELL

The aerobic process within the TWT pit makes them less smelly than a standard pit which can help with promoting toilet use. They also have fewer flies, meaning less disease vectors.



ONSITE

In a TWT the worms feed on the faeces, treating it by turning it into a denser and dryer soil-like vermicompost.

The vermicompost builds up much slower than raw sludge in a traditional latrine pit, resulting in reduced emptying frequency.

Vermicompost can be easily removed by shovel and can usually be buried on site.

Typical latrines use dry or wet pits or septic tanks to contain faecal sludge.

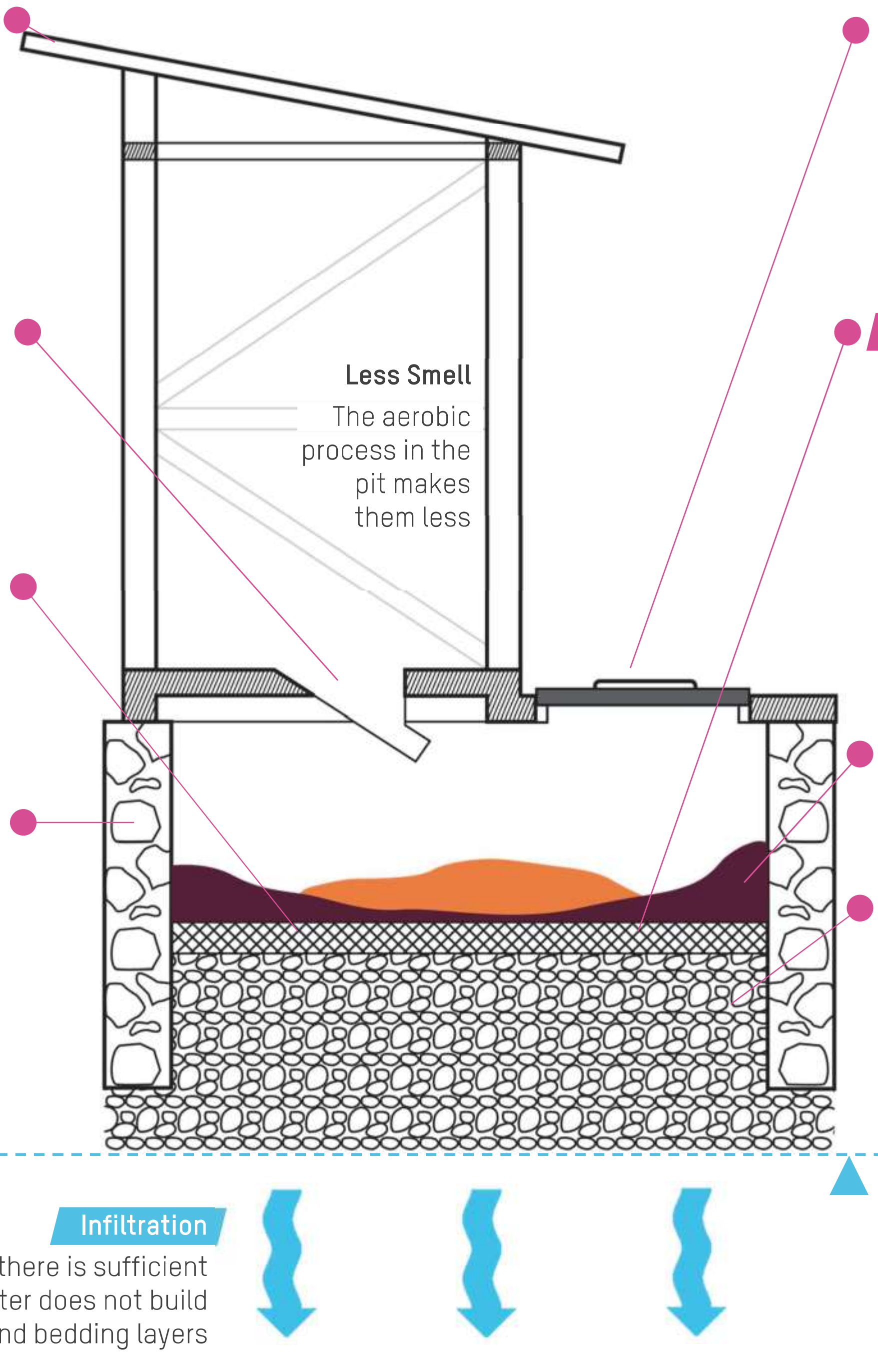
The wet faecal sludge is emptied either manually with buckets or with desludging pumps, which can be difficult to source. Desludging requires a trained team of people.

OFFSITE

Faecal sludge from traditional latrine pits or tanks requires transportation off site to faecal sludge treatment plants. This transportation and treatment is expensive to set up and requires ongoing operational budgets. In many contexts it is difficult for local governments or NGO's to sustain such services.

KEY FEATURES

OF A DIRECT DROP ‘POUR FLUSH’ MODEL USED IN SITTWE CAMPS



Superstructure

Can typically be the same as existing latrines. A roof to prevent rain water entering the pit.

Latrine pan

Low volume pour flush. Direct drop is possible if sufficient anal cleaning water is used.

Bedding Layer

This is where the worms live. Wood chips or coconut husks are suitable.

Single large vault

Made from masonry. Good quality of construction is required so pests cannot enter. This is especially important where the vault joins the lid.

Less Smell

The aerobic process in the pit makes them less

Monitoring & Emptying hatch

Large enough to carry out visual monitoring of the pit and vermicompost emptying

Worms

Composting worms live in the bedding layer and process the raw faeces

Vermicompost

Worm faeces, which is soil like

Drainage Layer

A gravel pack working as a liquid filter and support for the bedding layer

Infiltration

It is critical that there is sufficient infiltration so that water does not build up in the drainage and bedding layers

Maximum Water Table

It is critical that the water table does not raise into the drainage layer

TWTs can be built from locally available materials. The specific design of TWTs varies based on the local context and application.

COST BENEFIT ANALYSIS

	TIGER WORM TOILET	MYANMAR TRADITIONAL LATRINE
Latrine Capital (upfront) Costs	The cost to construct the toilet design The cost of worms, bedding material and drainage layer	The cost to construct the toilet design
Infrastructure Capital (upfront) Costs	NA	The cost to purchase desludging infrastructure if not already existing including trucks, pumps etc. The cost to establish faecal sludge treatment plants where not already existing. Include overheads and land as well as pure construction costs
	Divide the total cost by the total number of toilets that they will serve to give a capital cost per toilet	
Latrine Operating Costs	Based on an expected vermicompost emptying frequency of every 3 to 5 years (0.2 to 0.3 times per year) and the expected cost per emptying. Routine maintenance and monitoring staff cost.	The expected average annual desludging frequency based on an accumulation rate of 50 litres of sludge per person per year multiplied by the expected cost per time of desludging and off-site transport. Routine maintenance and monitoring staff cost.
Infrastructure Operating Costs	NA	Where not already existing, the annual cost to operate faecal sludge treatment plant/s. Depreciation of key desludging infrastructure such as trucks or specialist pumps.

When considering the overall cost benefit analysis for TWTs it is important to consider all upfront and ongoing operational expenditures for both the TWT and traditional latrines. It is also important to consider the non-financial considerations, such as operational ease or difficulty, the ability to handover to households or communities and the speed of implementation.

The Rakhine camp cost analysis (right) compares the cost if all 3,800 camp toilets had been TWTs from the start of the emergency response. In this case, no sludge treatment plant and transportation system would have been required. The 5-year saving is estimated to have been over $1 million on direct costs.

For the TWTs established in Rakhine camps during this project, the operational cost savings are estimated to be around $19 per toilet per year as the sludge treatment and transport infrastructure is already in place and functional.

Environmental impact could also be considered. In the Sittwe camps in Rakhine each year around 13,500 litres of diesel is used by the desludging tractors and around 2,500 litres of petrol for the desludging pumps. This creates around 40 tonnes of CO_2 per year. The aerobic process of the TWTs also produces less methane than traditional toilets.

COMPARATIVE COSTS IN RAKHINE CAMPS

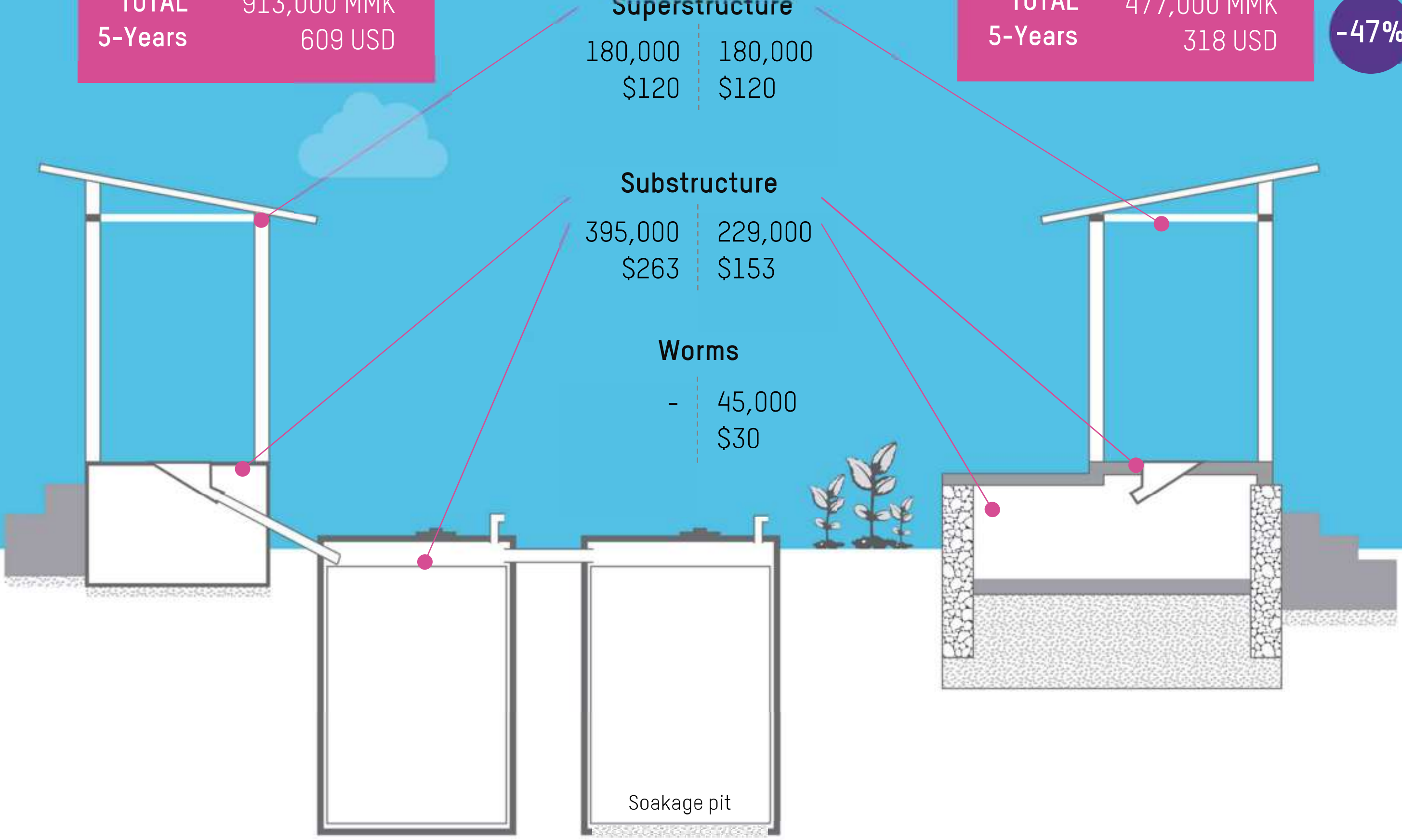
If all toilets were TWTs from the start of the response

TRADITIONAL LATRINE

Initial	693,000 MMK 462 USD
Annual	43,500 MMK 29 USD
TOTAL 5-Years	913,000 MMK 609 USD

TIGER WORM TOILET

Initial	454,000 MMK 303 USD	-34%
Annual	4,500 MMK 3 USD	-90%
TOTAL 5-Years	477,000 MMK 318 USD	-47%



Infrastructure	119,000 $79	-
Superstructure	180,000 $120	180,000 $120
Substructure	395,000 $263	229,000 $153
Worms	-	45,000 $30

ANNUAL

The project has found routine maintenance costs to be similar for both types of toilet. Only the variance in cost is considered here.

O&M and Monitoring	-	+ 2,250 + $1.5

The team expects that if all camp toilets were TWTs that monitoring costs would be $1.5 more per toilet per year.

Oxfam manages nine desludging tractors and seven desludging teams, desludging over 700 pits per month in Sittwe camps. The average cost per emptying is $11. On average each pit requires emptying twice per year.

Emptying & Transport	33,400 $22	2,250 $1.5

In Sittwe it is expected that trained labour will need to be hired to empty and bury the vermicompost every 2 to 4 years. The cost per time will be around $3. The vermicompost can be buried onsite next to the TWTs.

A large treatment plant was established to treat faecal sludge from around 3,800 latrines at a total cost of around $300,000 or $79 per latrine. It services around 920 pits per month at an average operational cost of $3.40 per pit per time.

Treatment	5,300 $3.4	-

The onsite treatment process of the TWT removes the need for a centralised treatment plant. As TWTs are simple to operate they are easier to handover than a complex treatment plant and desludging service.

CHALLENGES WITH WORM SUPPLY DELAY A PROJECT

Kachin in Myanmar was selected as a location to trial TWTs in 2014. After an extensive search only one worm supplier could be found in-country and the quantity of worms was not enough for the 10 TWTs planned. Importation from Thailand would be too complex and risky. The worms in Myanmar had to be transported to the project site via internal airfreight as the road journey would have been too long. It was challenging to find an airline that would accept transporting worms. As a result of these factors the project was delayed and TWTs more expensive than expected. The recent trial in Rakhine was able to find more suppliers in Myanmar and also established their own wormery to grow their own worms. A wormery was also established in Sierra Leone to provide worm supply.

WATER SCARCITY CAUSES PROBLEMS

In Dire Dawa, Ethiopia, it was difficult to find low-volume pour flush pans, so traditional high volume pans were used. As this was a water scarce area, people were put off from using the TWTs.

CONSTRUCTION QUALITY

In Gambella, Ethiopia, issues with the construction quality meant that there were gaps where rats or other predators could enter and eat the worms. In Kachin, Myanmar the concrete rings used for the pit were not properly sealed by the contractor resulting in surface water running in and flooding the pits after heavy rain, killing many of the worms. Due to these types of possible issues, being able to ensure construction quality is very important for TWTs.

WORMS

Several trials found that it is important to not focus on the worms themselves in community facing materials. It distracts potential users from seeing the benefits the TWT can bring to them.

KEY CONSIDERATIONS

While TWTs have been proven to function successfully in a range of contexts, key learnings from the TWT trials to date is that they are not the solution to all sanitation problems. Careful consideration of some key factors is required before deciding to implement TWTs as a sanitation solution.

WATER AVAILABILITY

TWTs are not suitable in areas where water is scarce. TWTs require water entering the pit to ensure that the worms environment remains moist. 2 litres per person per flush is desirable, making low volume water seal pans ideal. If the toilet is direct drop, users must use sufficient water for anal cleansing and pan cleaning to keep the worms environment damp/moist.

WORM AVAILABILITY

While suitable composting worms are readily available in some countries, such as South Africa and India, their availability in sufficient quantity has proved limiting in several trial countries. Wormeries can be established to grow your own supply but this adds some cost and takes time; approximately two months to double the stock of worms by weight.

SOIL INFILTRATION

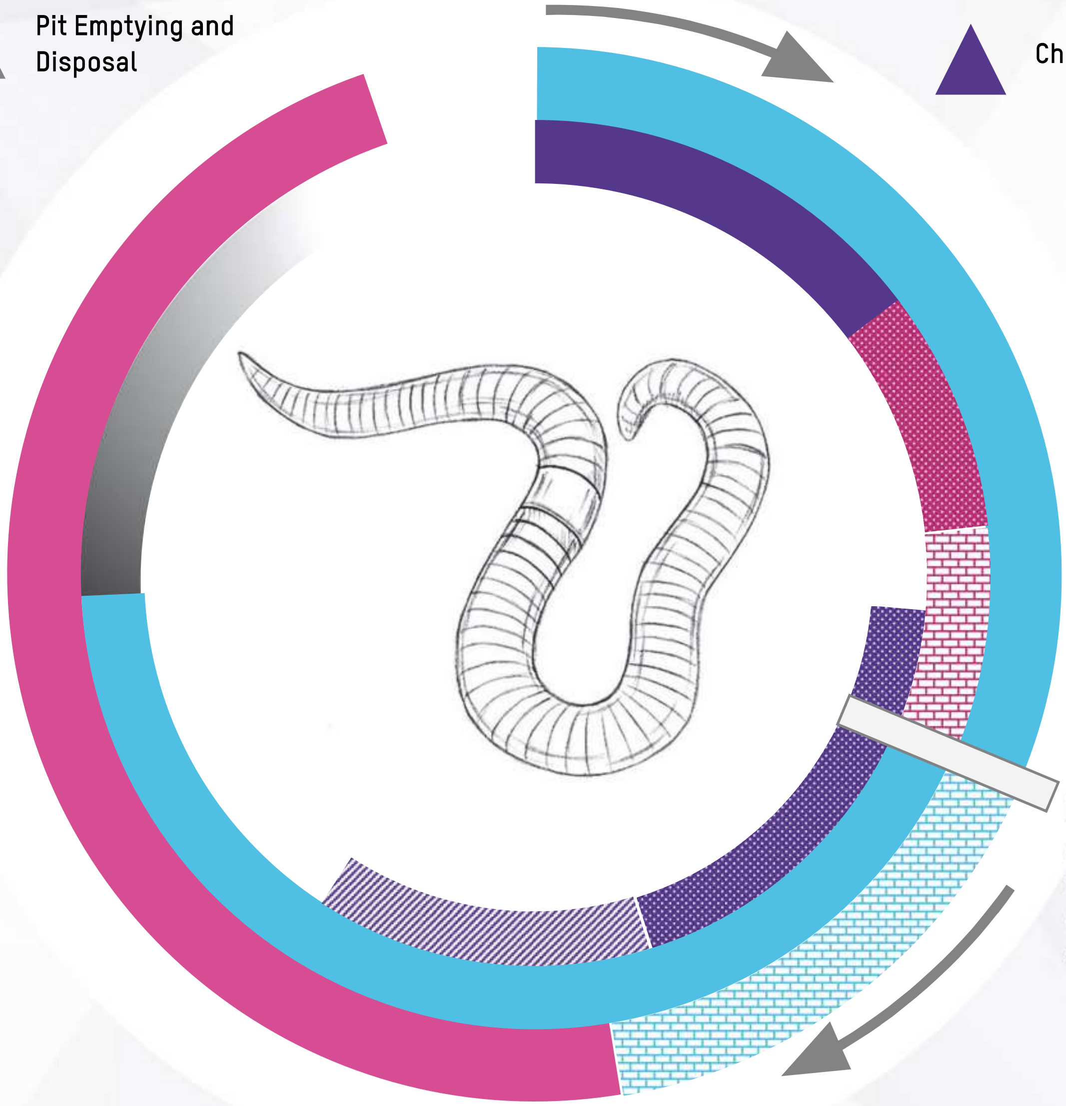
It is critical that the pit does not fill with water. The soil must be able to absorb the daily fluid inputs and the water table must not rise into the bottom of the pit. Soil infiltration tests are essential before deciding on a TWT design. Raised designs would be needed in flood prone areas. Additional infiltration trenches may be required where the infiltration rate of the pit is insufficient. If high volume pour flush pans are used, the soil must be able to absorb the total daily input without flooding the pit.

USER BEHAVIOUR AND ACCEPTANCE

It is essential to understand user current and expected behaviour prior to deciding on TWTs as a sanitation option. TWTs are not suitable in areas where the community uses only a very small quantity of water for anal cleansing and flushing. TWTs may not be suitable where communities are accustomed to throwing other waste into the toilet, unless this behaviour can be realistically changed.

HOW TO IMPLEMENT A TIGER WORM TOILET SOLUTION

TIGER WORM TOILET PROGRAM STEPS



Community Engagement:
Understanding Existing Behaviours ,
Attitudes and Water Availability

Pit Emptying and Disposal

Check Worm Supply

Ground Infiltration Testing

Toilet Design

DECISION
Are TWTs the most appropriate sanitation solution?

Implement IEC

Develop IEC

Monitoring

Community Engagement:
Correct use

Construction

Initial Informational Messages

1. A tiger worm toilet is a special type of latrine/toilet that requires less frequent and easier emptying making it cheaper and more convenient. It also smells less than a traditional latrine.
2. Composting worms live in the pits and eat the faeces, turning it into organic vermicompost.
3. The worms live in the pit and cannot be seen. They cannot escape or climb up the pipe.
4. To the user, a tiger worm toilet may look no different to a normal toilet. The difference is all in the pit. However, there are some difference in how you use and look after a tiger worm toilet.
5. The vermicompost that the worms produce is dry and soil like. It can be easily emptied by hand with a shovel and the compost buried onsite.

Be sure to allow a lot of time for questions and answers to make sure they digest the idea and express any fears or concerns they may have.

Community consultation process in STMG camp, Sittwe, Rakhine

INVOLVING STAKEHOLDERS

Experience of stakeholder involvement in Sittwe camps

Initial **information sharing** and **consultation** was carried out with key community stakeholders including community leaders, local authorities, religious leaders, women´s and youth groups. Households to be included in the project were selected together with these groups. This broad initial engagement helped ensure ownership and awareness of the project.

Meetings were held with groups of households in the two camps to assess existing **behaviors** (see following page), share further information and raise awareness about TWTs. As the communities in the two camps were different, this was done separately in each site. No major change in sanitation habits was required in either location.

As TWTs were a new concept, an inception workshop was held with local authorities and NGO stakeholders to **raise awareness and acceptance**.

Men, women and children were consulted separately on the **design** of the TWT structures in each camp. Changes were made to the design based on the feedback from these sessions before being finalized with the selected households.

Consultations with the selected households were carried out to agree the **roles, responsibilities and contributions** of households and Oxfam; including materials, cleaning, monitoring and emptying.

Formative research was carried out with women, men and children separately in each camp to understand the key motivating factors and barrier to latrine use. Reduced desludging frequency and reduced smell were the most appealing features of a TWT. People were not interested in knowing more about the worms or how they work. Generally, a sturdy, wide and smooth latrine floor is most valued.

The formative research findings were used to draft various **IEC** ideas and sketches which were shared with the groups for feedback and discussion. Based on this two designs were developed for each camp and pre-tested. Changes were made based on the feedback and a final IEC poster and leaflet developed for each camp.

Continued **close coordination** with the community leaders and other key power holders in the camp who have the potential to support or block activities.

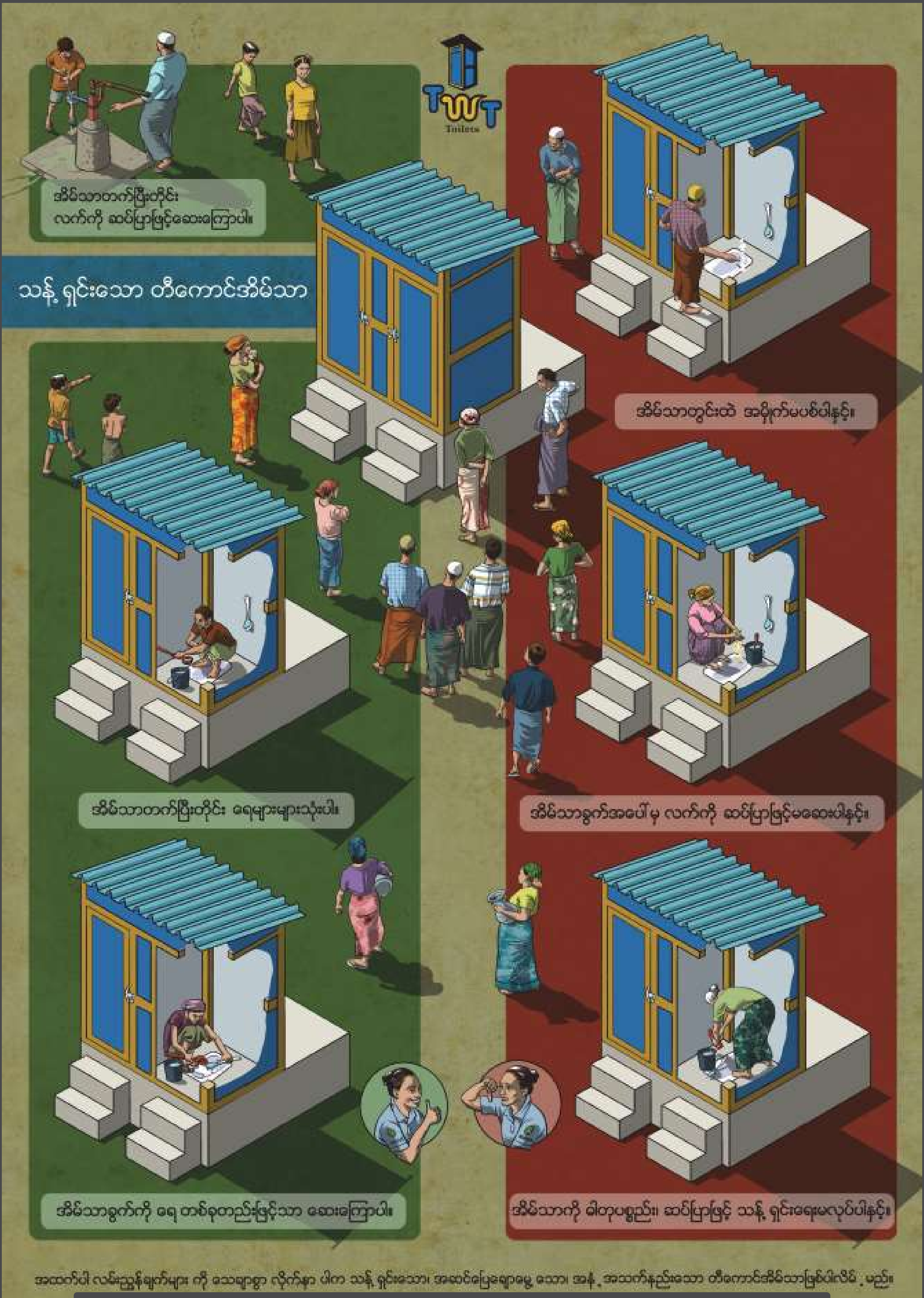
UNDERSTANDING EXISTING BEHAVIOURS AND ATTITUDES

Ensuring the correct use of a TWT requires more community engagement and mobilisation than would be the case with 'standard' latrines. A person experienced with engaging with communities must be involved throughout design and implementation. A comprehensive community consultation process is crucial to give people a sense of ownership and trust in the TWTs.

It is important to understand existing behaviours, in line with the criteria in the table below, before deciding to implement TWTs. The behaviour of all intended users may not be uniform, particularly where intended for communal or shared use. It is therefore important to ensure that people within each group are considered. TWTs are most suited where existing behaviours and practises are already suitable for a TWT. Where existing behaviours need to be changed in order to use a TWT, it must be considered if such changes are realistically feasible.

EXISTING BEHAVIOUR	**IMPORTANT BECAUSE....**	**CONSULTATION TOPICS**	**WHAT IT TELLS US...**
Availability and use of water	Water is required for when using the TWT	Where do communities get water for latrine use? How do individuals practice anal cleansing?	What kind of water is being used Saline water can harm the worms What is used for anal cleansing (i.e. paper, water, or other materials) and if behaviours need to be changed
Experience with flushing	Ensuring enough water after each use to maintain a good level of moisture in the pit for the worms	How do community members flush the toilet? How much water do they use? Community perceptions and current practices towards flushing toilets	If current flushing practices align with requirement of minimum 1.0 to 1.5 litres of water per flush and if additional awareness is needed on how to flush the TWT Attitudes towards toilet flushing
Latrine Use	To understand if everyone currently uses latrines and if not why	Who currently uses latrines, children, disabled, men, women, etc. Consultations to be held with each group separately	Are there any groups who do not currently use latrines and if so what are the reasons? Is there anything that can be changed in the TWT design to make them more accessible or desirable to these groups?

EXISTING BEHAVIOUR	IMPORTANT BECAUSE....	CONSULTATION TOPICS	WHAT IT TELLS US...
Greywater entering the system	Grey water will harm the worms	Where to people bathe? Do they normally bathe in latrine?	Does grey bathing water normally enter into existing traditional latrines? Do people have other places to bathe? Does the TWT design need to be modified to incorporate bathing where the water does not enter the pit?
Items entering the system	There are restrictions on what can be flushed down a TWT toilet	In addition to faeces, what do community members put 'down' the toilet?	If other items are being put down the toilet (i.e. garbage, cigarettes, nappies, menstrual materials, bottles etc.) then additional awareness is required about how these items might damage the TWT and a convenient alternative waste disposal option provided
Community opinions of worms	Communities may perceive worms in negative ways (i.e. lack of cleanliness)	Are worms used/accepted by the community for vermicomposting?	If the worms in the toilets will be accepted or if community sensitization is needed to explain what they are for, what they do, etc.
Cleaning of latrines	Chemical cleaners should not be used on the toilet bowl as the run-off into the pit will kill the worms	How are the existing latrines cleaned? What kinds of supplies are used?	If chemical cleaners are traditionally used, would a switch to water-only cleaning will result in communities perceiving toilets as 'unclean'
Desludging	Who will empty the pits when they fill up	What do households currently do when pits fill up? Who would be willing to empty the vermicompost?	Can household empty the vermicompost by themselves an bury it onsite, or would there need to be an emptying system established?



If you follow these instructions properly, the Tiger Worm Toilet is clean, comfortable and less smelly!

In Rakhine, communities were not interested in learning about the worms, how they function or how the key messages affect the worms. This has been the case in other countries also. Messaging can instead highlight the advantages of the systems such as ensuring proper use to maintain less smell and less emptying frequency and the financial saving that this can bring.

DEVELOPING KEY MESSAGES FOR RAKHINE

Communication materials and methods need to be developed specific to the local context. In some contexts, word of mouth through local influencers may be most appropriate, while in others printed educational materials may be preferred. General best practices for developing IEC materials should be followed including:

1. Focus on the most important key messages and consider any difference in key messages for different groups of the population. Avoid having too many key messages at a time.
2. Consult different groups of the population separately to explore key barriers and motivating factors.
3. If possible, find a local artist who can quickly sketch up IEC ideas for rapid testing with the target groups before developing ideas or designs in detail.
4. Think about the type of media and the location of media that will be most impactful, such as possibly inside the latrine door.

KEY MESSAGES

As with any latrine program, users need to have access to sufficient cleaning and personal hygiene products such as a toilet brush, bucket, jug or lota where appropriate and soap for handwashing.

BENEFITS OF A TIGER WORM LATRINE

LESS EMPTYING
TWT's require less frequent emptying, saving you time and money. They are also easier and cleaner to empty.

LESS SMELL
TWT's smell less than normal toilets

In order to get these benefits, there are some things that need to be ensured:

WATER

Use water to flush the toilet after every use, at least 1-litre (a lota)

NO DETERGENTS OR SOAP

Avoid using detergents that can kill worms - use only plain water to clean the latrine

DON'T THROW WASTE IN THE LATRINE

Do not throw solid waste, such as disposable pads, bottles, dry cell batteries, broken glass, metal etc., into the toilet, as these will stop the toilet functioning properly.

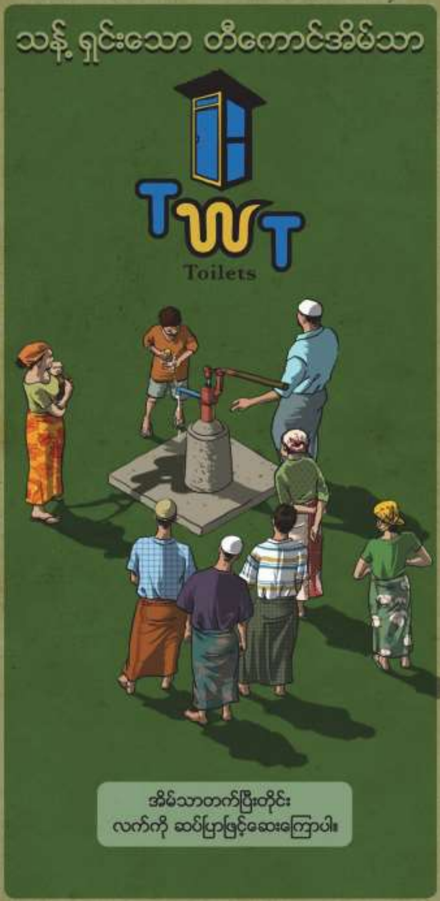
NO SHOWER OR BATHING

Avoid using the toilets for bathing or showering because excess water and soapy water isn't good for the worms

Sample IEC made for Rakhine ethnic locations

The clean Tiger Worm Toilet!

Always use some water after using the toilet



Always wash your hands with soap after using the toilet

Only use water to clean the pan

Sample IEC made for Muslim locations

The clean Tiger Worm Toilet!

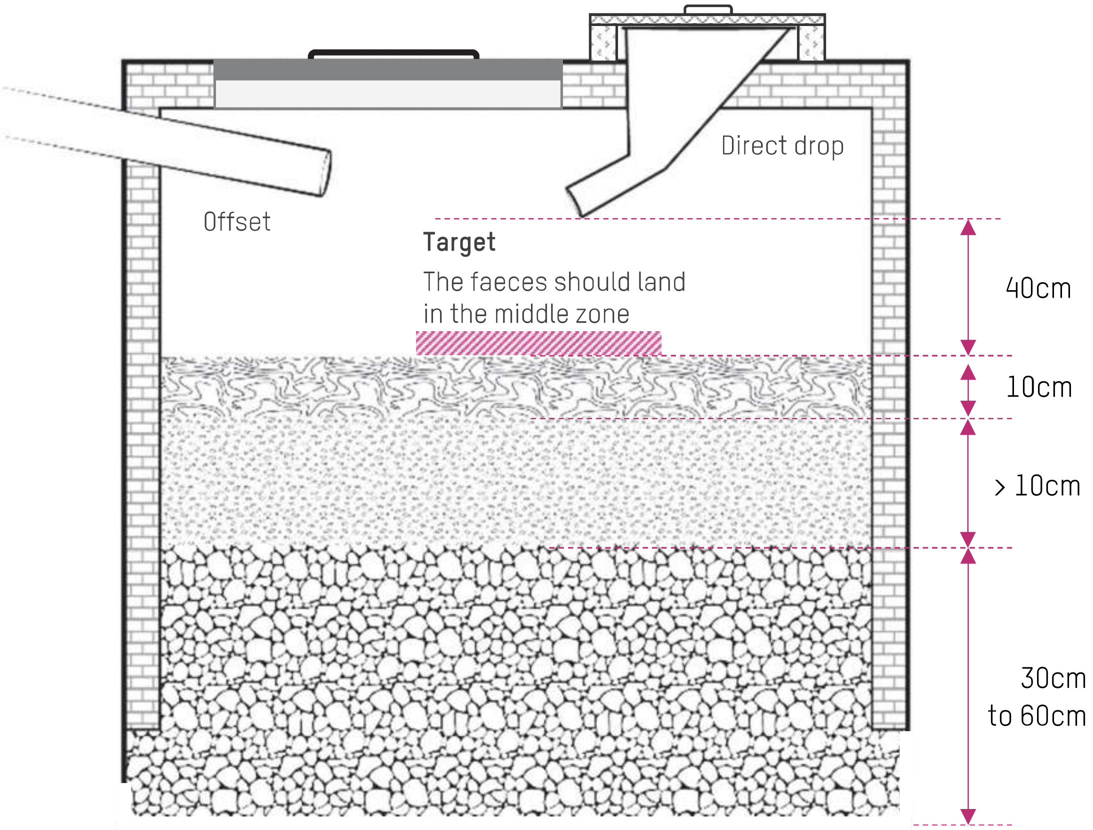
No waste in the pit

Don't wash your hands with soap on top of the pan

Don't use chemical soap to clean the toilet

TOILET DESIGN FACTORS

The superstructure of a TWT can be the same as existing traditional latrines, as long as there is a roof to prevent rain water entering the system. As with all latrines, it is essential that the community are consulted regarding the design, location and sharing arrangements.



Target
The faeces should land in the middle zone

Latrine Pan
Can be direct drop or off-set. If there is no water seal a cover is needed

Space
For the faeces and vermicompost to build up

Bedding Layer
Where the worms live

Drainage Layer
Small or medium gravel or similar

Drainage Layer
Course large gravel or hardcore or similar

Infiltration
It is critical that the infiltration rate is sufficient to prevent water building up and flooding the pit

Infiltration
If the infiltration rate is insufficient, consider a larger pit or infiltration trench

Maximum Water Table
It is critical that the water table does not raise into the drainage layer

THE IMPORTANCE OF CONSTRUCTION QUALITY

Ensuring good construction quality is particularly important for TWTs. This includes ensuring:

1. The system is properly sealed to prevent predators such as rats or centipedes from being able to enter the pit. The pit lid needs to be well sealed. If direct drop, a good fitting latrine pan cover is needed.
2. The pit is properly sealed on the sides to prevent rain and surface water entering the pit.
3. A well-sealed and large enough emptying and monitoring hatch.
4. The correct construction materials are used. The drainage and bedding layer do not contain too many small fine particles which could cause blockages.
5. The inlet pipe is installed correctly for new faeces to land in the center of the pit

TOILET DESIGN FACTORS

Drainage Layer

The drainage layer supports the bedding layer and provides an infiltration buffer zone where water can be held while waiting to infiltrate. The whole drainage layer should be at least 40cm deep. Depending on local materials, it may be preferred to place finer gravel (or similar) above a layer of courser gravel or hardcore (or similar). Ensure that there are not too many fine/small pieces which could cause clogging.

In Rakhine, 3-5cm diameter gravel was used with a depth of 40 cm.

Bedding Layer

This is where the worms live. It should be an organic material that does not quickly degrade, retains moisture, retains its structure to keep air flowing through the layer (aerobic) and filters out the solids that are flushed. Wood chips are ideal and coconut husks are also suitable. Ensure that there are not too many fine particles which could cause clogging. A depth of 10 cm is required to ensure that the worms have enough space to live and move around. The bedding layer must be soaked overnight in water before installation.

In Rakhine, coconut husk was used with a depth of 10 cm.

Space

There should be at least 40cm between the top of the bedding layer and the bottom of the entry pipe. This is the space where the vermicompost will build up and the fresh faeces will be processed.

Inlet pipe

The inlet pipe should be positioned in such a way that the faeces entering the pit lands in the middle. This can be easily tested during construction with a lump of wet tissue to simulate the faeces. If the tissue does not land in the central target zone then the pipe should be adjusted.

Latrine pan

Any type of latrine pan can be used, but low-volume pour flush pans are ideal. High volume pour flush pans will result in a lot more water entering the pit and potentially building up if the infiltration rate is not sufficient. They also require users to carry more water. Direct drop pans can be used if people use at least 1 to 1.5 litres per use for anal cleansing and pan cleaning.

In Rakhine two designs were used, a direct drop pan above the pit and an offset direct drop (traditional Myanmar latrine). If direct drop pans are used they should have a cover to prevent animals from entering the pit down the pipe and reduce flies.

Pit construction

The pit can be constructed from any suitable locally available materials. Bricks and concrete rings are common choices. In Rakhine the communal TWTs were constructed with a stone wall pit sealed with mortar. Whatever material is selected the pit must be properly mortared and sealed to prevent surface water runoff, animals and insects from entering the pit.

Monitoring and emptying hatch

TWT pits need to be easy to visually inspect. A monitoring and emptying manhole cover is required. It should be easy to open and close. It should be large enough that the vermicompost can be emptied with a spade. A minimum of 0.6m x 0.6m is suggested, but larger is preferable. It is important that is has a good seal to prevent water and insects from entering the pit.

TOILET DESIGN FACTORS

Determining the required infiltration capacity of the pit

The specific required infiltration capacity will depend on the type of latrine pan used. The required infiltration capacity of the pit can be determined using the method and formulas included in the annex. The table below provides a quick guide by using several general assumptions.

	Flushes per day		
Flush volume	2	3	4
1 litre	**1.5** mm/hr	**1.5** mm/hr	**2.0** mm/hr
5 litres	**3.5** mm/hr	**5.0** mm/hr	**6.0** mm/hr
10 litres	**6.0** mm/hr	**8.5** mm/hr	**11.5** mm/hr

Suggested minimum design infiltration rates: *table above assumes 1 litre for anal cleansing pppd, 1.5 litre urine pppd, adds a +25% safety factor, assumes* $0.2m^2$ *pit surface area pp and is rounded up to the nearest 0.5mm/hr.*

Determining the actual infiltration capacity of the pit

A simple infiltration test can be carried out and is essential for confirming that the actual infiltration capacity of the pit if greater than the required minimum design infiltration rate.

The below method is adapted from appendix H2 of the Building Regulations 2002 for England and Wales.

1. Excavate a test pit down to the expected level of the bottom of the TWT pit drainage layer. Ensure that this is above the highest level of the water table in the rainy season. The size at the bottom of the test pit should be large enough for the trial holes.
2. At the bottom of the test pit, dig two round trial holes with a diameter at the base of 300mm. Keep the sides of the holes as vertical as the soil type will allow. Space the top of the holes at least 300mm apart.
3. Fill the trial holes and allow to drain overnight.
4. The following morning fill the holes to a depth of 300 mm. Pour gently so to not disrupt the soil.
5. Record the time in minutes required for the water level to drop from 225mm to 75mm, a drop of 150mm.
6. Repeat this three times per hole.
7. Calculate the average time of all 6 tests.
8. Calculate the design infiltration rate using the formula below. It is recommended to reduce the calculated infiltration rate by multiplying by a safety factor of 0.6 to allow for some future reduction in infiltration rate that could be caused by clogging.

$$\underset{\text{(mm/hr)}}{\textbf{Design Infiltration Rate}} = \left(\frac{150\text{ mm} \times 60}{\text{Average time in minutes}} \right) \times \underset{\text{Safety factor}}{0.6}$$

TOILET DESIGN FACTORS

👥	**Number of Users per Toilet**	The number of users determines the amount of worms that are required, which then determines the surface area of the pit that is required. In Sittwe two types of TWT were established, one design for a single household (6 people) and another design for a shared toilet (5 household, 30 people).
〰	**Quantity of Worms per Toilet**	Composting worms have the ability to consume their own body weight in waste each day. An average person produces 200gr of faeces per day. Therefore at least **200 gr of worms are required per person.**
m^2	**Surface Area of the Pit**	Each **1 kg of worms requires at least 0.5m^2 surface area** of bedding layer. This is equivalent to **0.1m^2 per person** who will use the toilet. The minimum suggested surface area is 0.7m^2.
↓	**Soil Infiltration Rate**	It is essential that the bedding layer does not become saturated and that the pit is able to infiltrate the daily input of water without accumulating above the drainage layer. If the soil does not have sufficient infiltration ability for the area of pit determined by the number of people (above), then either (1) the pit will need to be made larger until the infiltration capacity is sufficient, or (2) additional alternative infiltration will be required, such as infiltration trenches.

The following table provides a guide as to the expected quantity of worms and surface area required for different numbers of toilet users, together with the associated minimum internal diameter for a round pit or minimum internal length for a square shaped pit.

👥	〰	m^2	⊖	⊞
5 people	1 kg	0.7	> 0.9 m	> 0.8 m
10 people	2 kg	> 1.0	> 1.1 m	> 1.0 m
20 people	4 kg	> 2.0	> 1.6 m	> 1.4 m
30 people	6 kg	> 3.0	> 2.0 m	> 1.7 m

*TWTs can be designed for more than 30 people by following the design guidance above.

RED (TIGER) WORMS

INDIAN BLUE WORM

AFRICAN NIGHTCRAWLER

Other types of composting worms exist

WORMS

Composting worms can eat up to their own bodyweight each day. They reduce the volume of faeces by converting it to carbon dioxide, water, ammonia, and vermicompost (worm faeces), which is dense and has less water.

In many countries, such as Thailand, Bangladesh, India and South Africa, composting worms are grown commercially for processing of organic waste into vermicompost. However, in Myanmar as in some other trial countries, the quantity of available worms available from suppliers has limited the speed at which TWTs could be installed. In some cases, worm supply can be expensive and therefore both the available quantity and cost must be considered before committing to TWTs as a sanitation solution.

WHAT TYPE OF WORMS CAN BE USED?	If a worm can be confirmed as composting then it is very likely be suitable for a tiger worm toilet. There are several different species of composting worm and they are widely available around the world. The Red (Tiger) Worm (Eisenia Fetida or its close relative Eisenia Andrei), the African Nightcrawler (Eudrilus Eugeniae) and the Indian Blue (Perionyx Excavatus) are common types. Identifying specific species of worms is difficult and is not necessary.
SOURCING COMPOSTING WORMS IN MYANMAR	In Myanmar, Oxfam has been able to identify several different suppliers who grow worms for composting (see annex). Typically, around 5 kg of worms has been available; enough for a single shared 5 household TWT.
GROWING YOUR OWN WORMS	Wormeries can be easily established to grow your own supply but this adds some cost and takes time; approximately two months to double the stock of worms by weight. If the wormery is large enough, it is fastest to wait until the entire required supply of worms has been grown rather than taking out some each month. Guidelines on setting up and operating a wormery can be found in the annex.
PREDATORS	Worms have various predators including birds, snakes, small mammals and invertebrates. Predators of particular relevance for TWTs are mice, rats and centipedes. Ants can aggravate the worms. Care should be taken to ensure that the toilet is well sealed to avoid predators entering the pit. Flies, maggots, cockroaches and ants are not predators of composting worms.
CAN THE WORMS ESCAPE?	There is nothing physically trapping the worms in the toilet, but they will remain inside the pit as long as the environment created for them is suitable. One of the most significant aspects of this is ensuring that users flush the toilet with water, but that the drainage is adequate to prevent the bedding layer becoming too wet and saturated.

EMPTYING

Ideally, the toilets are emptied after being left un-used for one week to allow the fresh faeces to be converted into vermicompost.

1. Vermicompost still contains pathogens, so health and safety precautions should be followed.
2. Dig a small disposal pit nearby to empty the vermicompost into. Ensure that it is deep enough for the vermicompost to be covered with 30cm of soil.
3. Remove the vermicompost from the edges of the pit using a small spade. Avoid any fresh faeces.
4. Try to not remove the vermicompost in the centre of the pit or the original bedding layer, as this is where many of the worms live.
5. Bury the removed vermicompost in the nearby disposal pit and cover with 30cm of soil.
6. The remaining vermicompost in the middle of the pit should then be spread across the surface to create a new bedding layer. Additional bedding material can be mixed in but is not essential.

During the emptying process it is ok that some worms will be removed from the pit.

In Rakhine, no TWTs have yet required emptying. It is expected that the shared TWTs will be emptied by the existing latrine desludging workers and that the vermicompost will be buried on site. The individual household TWTs have been handed over and the emptying will be managed by the households directly.

LESSON FROM MYANMAR

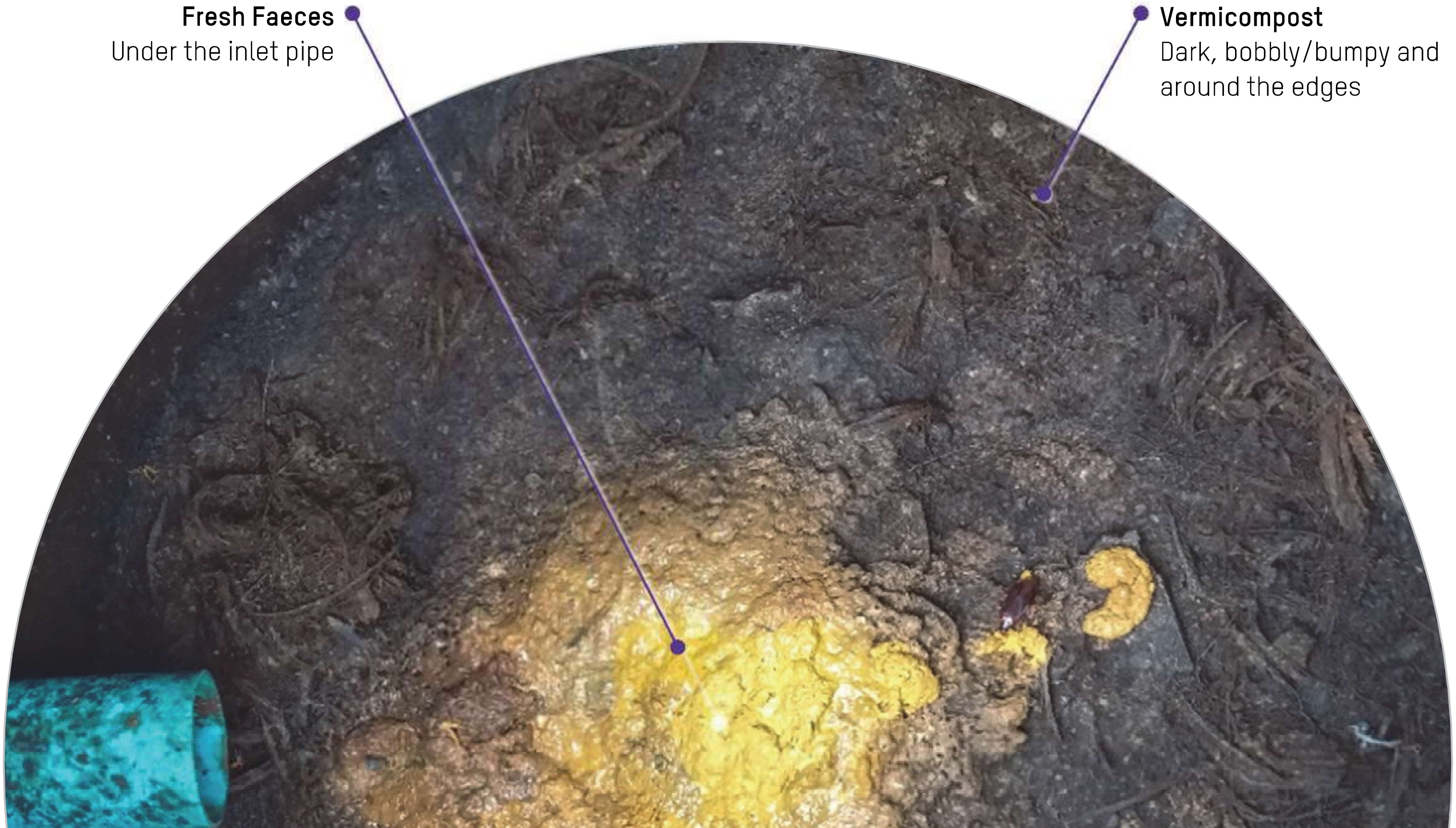
Pit Flooding: In one of the project sites, where the individual household TWTs were located, many of the pits became very saturated during the rainy season and stopped working as TWTs. The field team reported that this particular area experiences a high ground water table during the rainy season and that in some areas the infiltration rate is very poor.

If the pit is found to be flooded, try to determine the likely cause:

Temporary due to rain entering the pit	Re-seal the pit to prevent rain water from entering again
Insufficient Infiltration	An infiltration trench, or similar, will need to be retro-fitted or the number of users reduced to prevent continued flooding
High ground water table	If this is unusual and temporary, wait for the pit to drain, check for worms and re-seed with new worms if needed. If this is a long term problem the TWT will not function properly and will need to be decommissioned and rebuilt with the base of the pit above the highest water table level
More users than expected	Advise the toilet owner that the toilet only functions properly with up to the designed number of users

OPERATION

HOW OFTEN TO CHECK A TIGER WORM TOILET PIT?	Tiger worm toilets should be checked at a similar frequency that traditional faecal sludge pits would be checked for sludge level; roughly every 3-months. Where potential problems are identified follow-up monitoring will be required after 2 to 4 weeks.
WHAT TO CHECK AND HOW DO I KNOW IF IT IS WORKING PROPERLY?	The monitoring form can be used to guide the routine monitoring checks. Fresh faeces should not be building up beyond 90% of the surface area, vermicompost should be building up around the sides and there should usually be worms visible under the surface.
WHAT DOES VERMICOMPOST LOOK LIKE?	Vermicompost will be dark and bobbly (bumpy) and should be building up around the edges of the pit. Using a stick to look under the surface it should still be dark and a bit soil like. If it is bright colour under the surface then it is not vermicompost but accumulating fresh faeces.
HOW TO KNOW WHEN TO EMPTY?	When the level of faeces raises up to the level of the inlet pipe it is time to empty the pit.
HOW OFTEN WILL IT NEED EMPTYING?	Trails so far suggest that household TWTs will require desludging between every 3 to 5 years. In Rakhine camps, where traditional pits are desludged every 6-months, it is expected that TWTs will require emptying every 2 to 4 years.


Fresh Faeces
Under the inlet pipe

Vermicompost
Dark, bobbly/bumpy and around the edges

OK

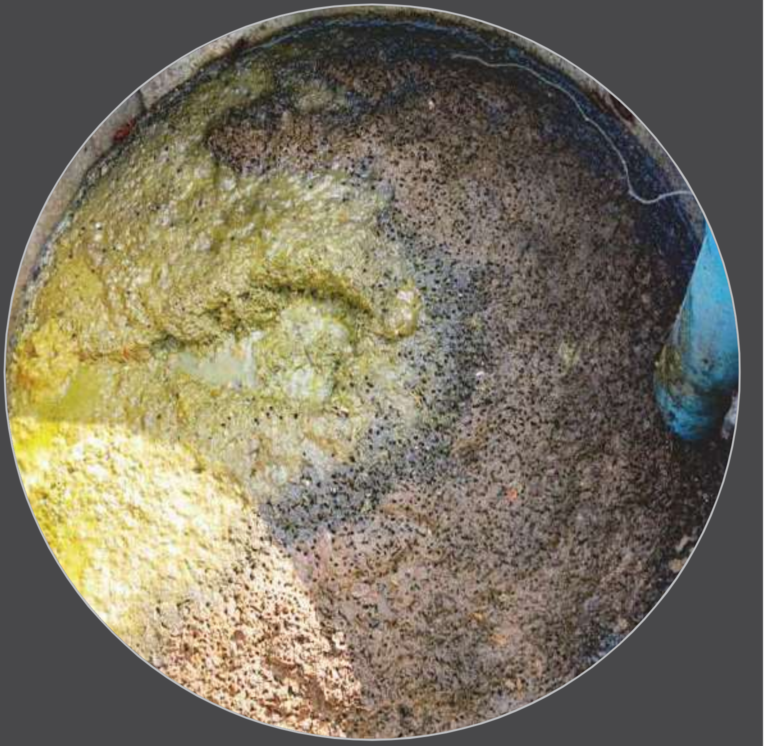
Wood shavings bedding layer. Fresh faeces in the centre with maggots. 25% coverage of fresh faeces. A bit dry around edges, but ok where the faeces is. Some dry vermicompost at the top and left, with white mould/fungus growing on top, which is ok.

OK

Wood shavings bedding layer. Fresh faeces in the centre with maggots. 10% coverage of fresh faeces. A bit dry around edges, but ok where the faeces is. Dry vermicompost around the edges, with white mould/fungus growing on top, which is ok.

OK

Wood shavings bedding layer. Fresh faeces under the pipe, but would be better in the centre. Suggests that the inlet pipe was not set up correctly. Patches of dry vermicompost with white mould/fungus growing on top, which is ok.



READY TO EMPTY

Fresh faeces is building up, showing that the pit is no longer functioning correctly. Dig under the brown area to see the colour and texture beneath. If it looks bright like fresh faeces, then the pit is not functioning and it should be fully emptied. If dark and lumpy, it is vermicompost and should be emptied.

WAIT AND SEE

Fresh faeces is building up. The pit looks too wet, but it looks recent rather than chronic, as there appears to be vermicompost, which means that the pit has been working well. This could be a case of water infiltration after rains or high water table. Monitor in 1-3 weeks (depending on rain) to see if the pit is drying and fresh faeces reducing. Empty if the faeces reaches the pipe.

OK, ENSURE A PROPER PIT SEAL

Vermicompost around the edges shows that the pit is functioning. Fresh faeces appears to be building up a little. Check again in 1-3 weeks (depending on rain) if the amount of fresh faeces is reducing. The cockroaches are not harmful for the worms, but if the pit is not well sealed, they can leave and transmit diseases. Make sure the pit and latrine are well sealed.

OK

Coconut husk bedding layer. Fresh faeces in the centre, around 15% coverage. Vermicompost appears to be building up around the edges and looks like dark, bobbly soil. This pit is working well.

OK

Looks ok. Fresh faeces building up a bit. Check under dark surface around edges. Looks like vermicompost, but if bright colour under the surface, then it is fresh faeces.

NOT IN USE

Some dark soil-like vermicompost but no fresh faeces and dry. Check under surface for worms or worm eggs. Find out why the toilet is not is use. If no worms or worm eggs, it will require re-seeding when the toilet starts being used again.

TOO WET

The pit is almost full, faeces is almost reaching the inlet pipe. The pit is too wet but there will probably be worms under the surface in the drier patches. Stop using for a week to see if the worms process the fresh faeces and the pit become less wet. Then empty the darker vermicompost at the edges.

OK

Coconut husk bedding layer. Slightly too dry at the edges but ok. Vermicompost can be seen building up like dark soil around the edges. Fresh faeces is building up a little. Try to not use for a few days and see if the fresh faeces reduces.

TOO WET

It doesn't look like fresh faeces, which suggests that the pit has been functioning but has recently become too wet. This means it is more likely due to infiltration from rains or rising water table rather than too much water from users. Check again after some days of no rain.

OK, BUT A BIT WET

Vermicompost is being produced, it is bobbly and dark. The pit is a bit too wet, but worms can be seen. Some of the vermicompost areas could be emptied now.

OK

Lots of nice vermicompost building up. Fresh faeces can be seen in another part of the pit. The pit is functioning well.

TOO DRY

Coconut husk bedding layer. Only a little fresh faeces and quite dry, suggesting that not enough people are using the toilet. Check how many users and that they are using at least 1.5 litres per time. Dark soil like vermicompost can be seen in the pit.

OK

Dark and bobbly vermicompost can be seen around the edges. The amount of fresh faeces is ok. The white colour is a fungus/mould and is ok. The water content is ok, not too dry and not too wet.

To confirm that the number of users has not increased beyond the design capacity of the TWT (max 1 user per 0.1m2 pit surface area)

The superstructure observations give an indication if the correct toilet usage instructions are being followed, such as only using water for cleaning

If the tank smells of bleach or cleaning products, the users need to be reminded that this can kill the worms.
If the tank smells of rotten eggs it suggests that the systems has become anaerobic and that that it is no longer functioning correctly

If the faeces is building up as a cone then it is not distributing properly and the worms are not able to access it. There may be a problem with the inlet pipe.

If fresh faeces are building up and covering more surface area then the worms are not processing the faeces fast enough. If there is >90% coverage of fresh faeces then there may be a problem.

MONITORING FORM

Name of person collecting the data: ____________________

Date: ____________________

Site Name: ____________________

Tiger Worm Toilet (TWT) Number: ____________________

Section 1: Questions to ask the person in charge of the TWT

1	How many people (including children) use this toilet as their primary toilet	.... people

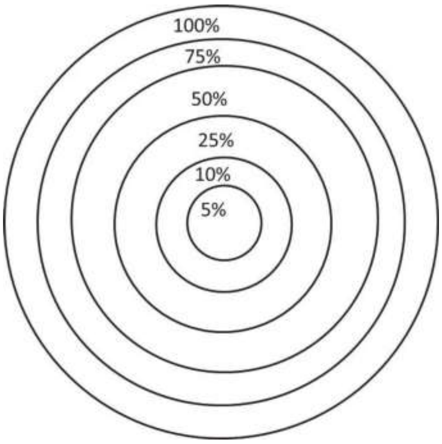
Section 2: Structured observations in the superstructure TWT

Is the superstructure clean?	Yes ☐	No ☐
Does the superstructure smell?	Yes ☐	No ☐
If yes, what does it smell of?	Bleach☐ Urine ☐ Poo ☐ Other ☐add details....................................	
Are there lots of flies in the superstructure?	Yes ☐	No ☐
Are there any cleaning products in the superstructure?	Yes ☐	No ☐

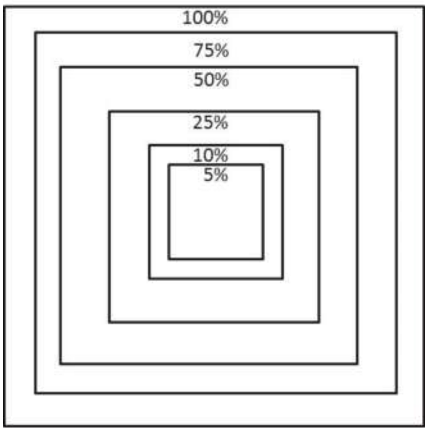
Section 3: Structured observation of the TWT pit/tank – Open the manhole cover

Does the tank smell?	Yes ☐	No ☐
If yes, what does it smell of?	Bleach ☐ Urine ☐ Poo ☐ Other ☐ add details........................	
Do any flies come out?	Yes ☐	No ☐
Estimate the depth of the poo/liquid	.... Inches.	
Is it mainly poo or liquid?	Poo☐ Liquid ☐ Half and half ☐	
How is the poo distributed?	Flat across the surface ☐ Cone like ☐	

What percentage of the surface of the system is covered by the fresh poo?



Approx ....%



TROUBLESHOOTING

	If	Then
〰	No worms can be seen in the toilets	It can often be difficult to find the worms, so check again after a few weeks and monitor if the fresh faeces is building up. Empty the faeces if the build-up is too much and re-seed the pit with new worms. Try to determine the cause and therefore what may need to be changed or repaired.
〰	No vermicompost is being produced	If worms can be seen, but no vermicompost can be seen check all other factors that contribute to good operation; water quantity, aerobic bedding layer, no cleaning products etc.
〰	Fresh faeces is building up, covering 100% of the pit surface	Check the number of users is as expected. If too many users, advise the toilet owners. Otherwise, the pit may require more worms.
💧	The pit is flooded or has been flooded	Check for worm presence after the flooding event. If worms are no longer present, normally there will still be worm eggs which will hatch to re-seed the pit once conditions are correct. Due to the time for worms to grow, the pit may require additional new worms, check every 2-weeks. Investigate the cause of the flooding and remedy if possible.
💧	The pit looks too dry	Check if the numbers of users is as expected, are there too few? Advise the toilet users that they need to use more water to ensure the TWT benefits and keep it functioning correctly.
💧	The bedding looks too wet	Check if the numbers of users is as expected, are there too many? Are people using more water than expected and designed for? Could rain water be coming in through cracks in the pit or gaps in the lid? If no, the infiltration rate may be less than expected and/or the drainage or bedding layer clogged. Check again after 1-week if the pit had drained. If no, check if bedding or drainage layer looks clogged by digging down. If no, an additional infiltration trench may need to be installed.
🪲	You find rats or centipedes in the pits	Remove them from the pit. Check how they could have entered and repair the toilet to prevent them from entering again.
🪲	You find cockroaches or maggots in the pit	Cockroaches and maggots are not harmful to the worms but can spread disease when they leave the pit. Check how they could have entered and repair the toilet to prevent them from entering again.
👤	There is a rotten egg smell when opening the pit	The pit has become anaerobic and the worms do not have an airy enough environment. Empty the sludge and vermicompost from the pit and add some new bedding layer.

FAQ

What stops the worms from escaping either down into the soil or climbing out of the pit?

When the environment in the pit is correct, the worms will stay present. They will not climb out of the pit.

How do you prevent the worms getting too hot or too cold?

The optimal temperate range is from 5 to 35 degC. The construction of the pit helps keep the worm environment at a stable temperature. TWTs could work in all areas of Myanmar.

Can medical drugs, alcohol or any disease in people harm the worms?

No. Diseases in humans will not affect the worms. Drugs and alcohol would be in too low concentrations to affect the worms.

How do you know the maximum level of the water table?

The local community will likely know this, particularly if there are dug well or handpumps. Local borehole and toilet contractors are also good sources of information.

How long can I wait between putting the worms in the pit and people starting to use the toilet?

People should start using the toilet at the same time as the worms are placed in the toilet. If this is not possible, food should be placed in the pit for the worms, such as cow manure or organic food waste and water the pit each day to maintain the moisture until the toilet starts to be used.

Can people start using the toilet before the worms are placed in the pit?

People can start using the pit up to a month before the worms are added to the pit.

How much do worms cost?

This varies significantly by country. Identify and contact possible worm suppliers to confirm the cost and available quantity before deciding to use TWTs. In Myanmar in 2014 worms cost over $200 per kg. In Myanmar in 2018 worms have been purchased for $10 per kg.

How to transport worms from the supplier to the site?

See the worm transportation guide in the annex.

How does desludging frequency compare to a normal toilet?

This depends on the number of users and size of a normal toilet pit. In the Rakhine camps the TWTs did not require emptying in more than one-year, whereas the normal camp toilets normally require desludging every 6-months. Single household TWTs have been shown in other countries to only require emptying after 5-years. A traditional pit latrine with a 1.5m^3 pit and serving a 5 users would also be expected to only require emptying after 5-years.

Can we use the vermicompost as a fertilizer?

There is not yet enough evidence to support using vermicompost as fertiliser on crops or fruit trees. Therefore this should not be done.

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ANNEX

COW MANURE AND CHOPPED BANANA TRUNK READY TO BE MIXED TO SET UP A NEW WORMERY

WORMERIES ESTABLISHED IN RAKHINE, MYANMAR, IN PLASTIC DRUMS, UNDER SHADE AND ABOVE THE GROUND

ANNEX – SETTING UP A WORMERY

Even though there are several composting worms suppliers in Myanmar, getting worms in large enough quantities for tiger worm toilets may not be that easy. Setting up your own wormeries might be the easiest solution to meet the need. Here are the key things to consider for setting up wormeries:

Wormery construction
Different types of materials can be used to set up a wormeries box, i.e carton box, plastic drum, temporary box made of tarpaulin with bamboo frame, or masonry brick basin. It should be located in the shade to prevent overheating, protected from direct rain, have a cover to protect from birds, elevated from the ground, and with a drainage system to prevent water build up and flooding. The surface area is a critical factor, 1 square meter area is enough to grow 2 kg of baby worms.

Bedding material
Use organic materials for the bedding area mixed with cow manure (as the source of food for the worms). Rice straws layer to be places at the bottom to filter the liquid, mix cow manure and chopped banana trunk on top of it (banana trunk is good to maintain moisture). Use 10 to 20cm depth of bedding materials.

Feeding
The food should be periodically topped up as the worms process it. Cow manure has been found to be an excellent food. Organic food waste is also suitable.

Watering
To maintain the right moisture inside the wormeries, adding enough water twice a week may needed. The amount of water needs to be carefully measured to ensure that all the bedding materials are soaked but not flooded. The drainage system bellow can be used to regulate the water.

Protection from rodents
Beside the top cover (to protect birds preying on the worms), ants and other insects are the common rodent for the worms. Using ant-chalks or anti-insect painting is necessary to protect the wormeries being invaded by unwanted predators.

Harvesting the worms
Successful wormeries can double the weight of worms within 6 weeks. Experience suggests that the India blue and Africa night crawler worms multiply faster than the Red worm. When it's time to harvest the worms a wormery of 2 m^2 will require at least 2 labourers for a 5-6 hours. It is labour intensive as it requires removing the compost & bedding materials batch by batch and finding and separating worms by size; mature large size and small baby size.
The mature large worms can be removed and used in the TWTs and the smaller baby worms and the compost & bedding materials are put back into the wormeries. Add some extra food and new bedding materials for the next growing cycle. It's important to make sure all the old food, compost and bedding materials are put back into the wormeries, as there may be a lot of worm eggs inside this mix.

WORM SUPPLIERS IN MYANMAR

There are several known suppliers of suitable composting worms in Myanmar. Mostly they grow red worm, India blue or African night crawler for agricultural purposes. Contact Oxfam in Myanmar logistics team for further information.

WORM TRANSPORTATION

1. The worms will need ventilation so we suggest you package them in breathable plastic weave or muslin bags. Jerry cans with holes on top to allow air flow have been used before. The holes need to be small so the worms cannot escape.

2. For every 1kg of worm, you need to have at least 1kg of bedding / vermicompost material.

3. The worms need to be kept moist so the bedding should be wet - packing with shredded damp cardboard or coconut fibre and moist soil is suitable. We do not recommend putting dry bedding on the top.

4. Place the worm bags in a box with a considerable amount of padding e.g. shredded paper (to absorb vibrations). Do not to use polystyrene boxes as air cannot circulate (the worms need to breathe).

5. Send the package as soon as it is boxed up – we suggest you do this at the start of the week - to avoid them getting stuck in storage over a weekend.

LESSONS FROM MYANMAR

Bangkok to Yangon: A batch of worms was imported via road transport, a 3 to 5 day journey. Roughly 50% of the worms died despite following the guidelines. It is thought that the excessive vibrations from the poor roads likely caused the worms to become over stressed and die.

Yangon to Sittwe: All worms were sent via air due to concerns that the 2 day road journey would cause too much vibration and stress for the worms.

Airlines in Myanmar were not always comfortable transporting worms and in some cases refused. The batch from Bangkok, where a large proportion of the worms had already died, caused the plane to smell bad leading to a serious complaint from the airline.

Other batches were hand-carried on the plane. It was found that batches that were transported in breathable containers had a 100% survival rate.

DETERMINING THE REQUIRED INFILTRATION CAPACITY OF THE PIT

The table below provides a quick guide by using several general assumptions.

	Flushes per day		
Flush volume	2	3	4
1 litre	**1.5** mm/hr	**1.5** mm/hr	**2.0** mm/hr
5 litres	**3.5** mm/hr	**5.0** mm/hr	**6.0** mm/hr
10 litres	**6.0** mm/hr	**8.5** mm/hr	**11.5** mm/hr

Suggested minimum design infiltration rates: *table above assumes 1 litre for anal cleansing pppd, 1.5 litre urine pppd, adds a +25% safety factor, assumes 0.2m² pit surface area pp and is rounded up to the nearest 0.5mm/hr.*

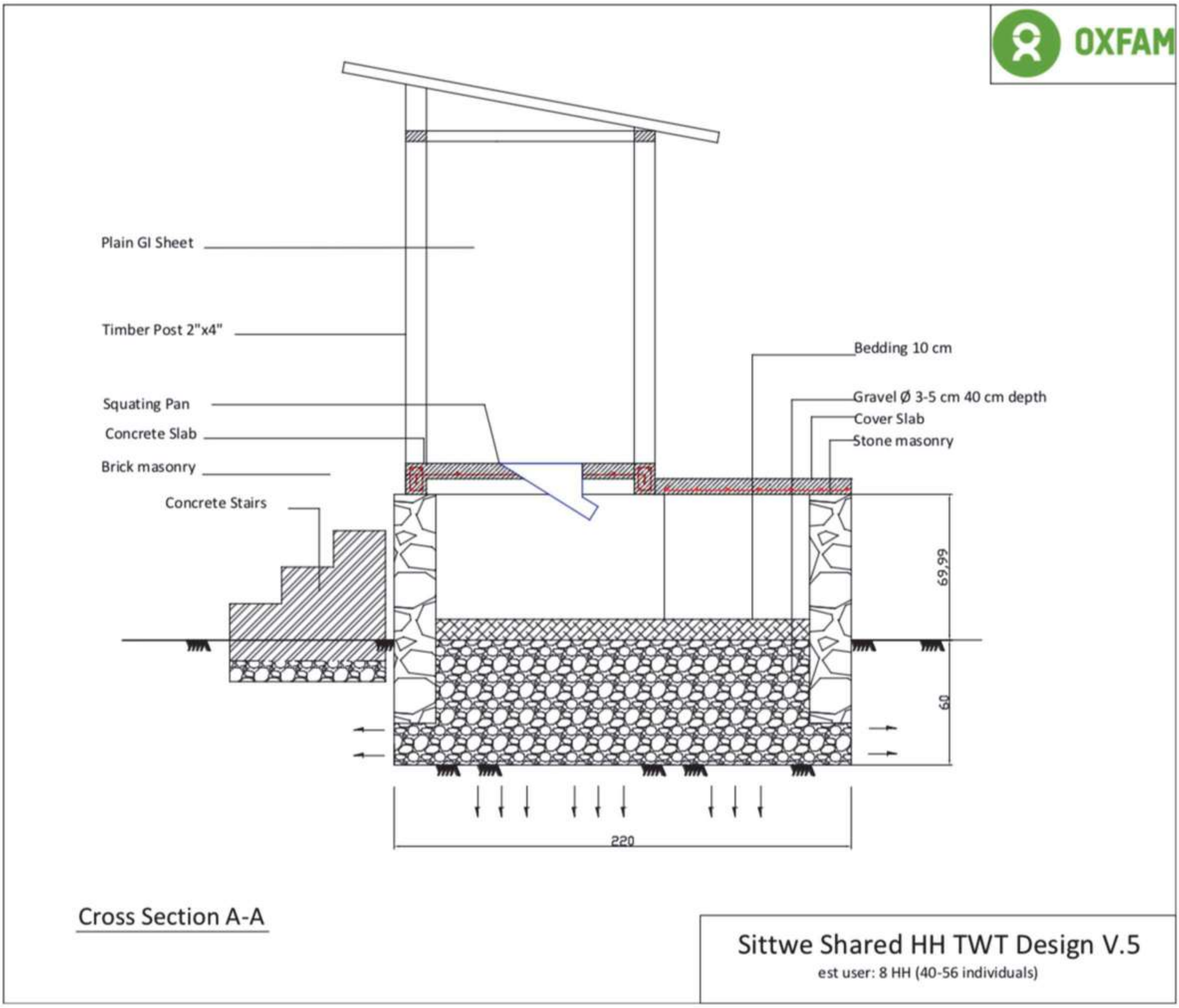
The actual specific required infiltration capacity of the pit can be determined using the method below.

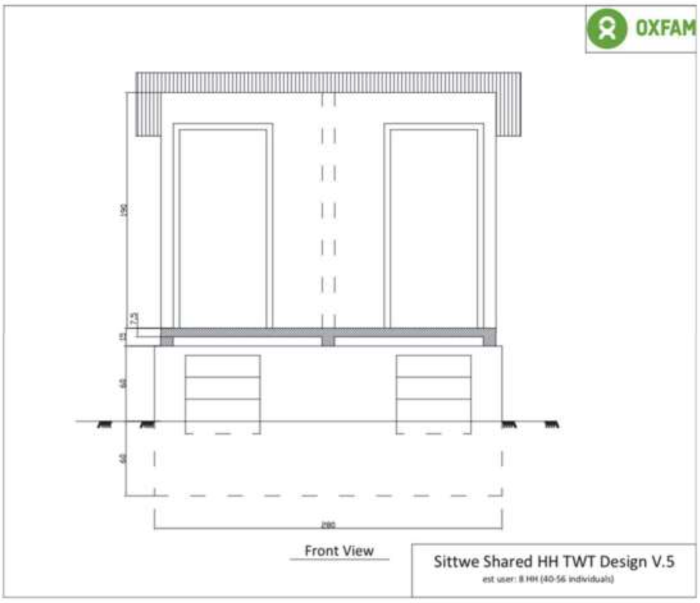
The specific required infiltration capacity will depend on the type of latrine pan used. For example, a pour flush latrine that requires 7 litres to flush, which is used by 5 people who on average each flush twice per day will require a daily infiltration of 70 litres, plus 1.5 litres of urine per person (total 7.5 litres) plus any water used for anal cleansing that falls into the latrine pan, in this example 0.5 litres per person per day (total 2.5 litre). Therefore a total of 80 litres. As the number of users can some days be higher, for example due to visitors, it is advisable to add a safety factor of at least 25%. Therefore 80*1.25 = 100 litres per day.

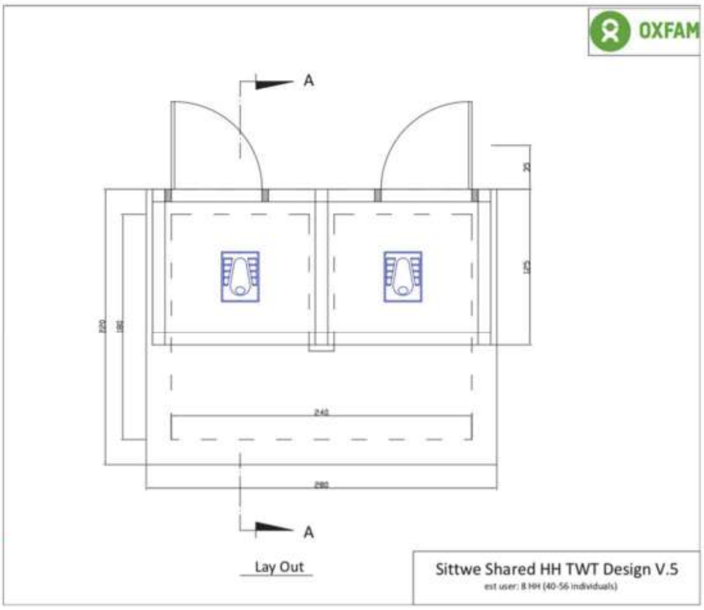
$$\textbf{Daily Water into the Pit (liters)} = \left[\underbrace{\left(\text{Liters required to flush the toilet type} \times \text{Expected flushes per person per day}\right) + \text{Liters of water used for anal cleansing} + \text{1.5 liters urine}}_{\text{From community consultation and/or observation}}\right] \times \text{Maximum number of expected daily users} \times \text{1.25 Safety factor}$$

$$\textbf{Required Minimum Infiltration Rate (mm/hr)} = \left(\frac{\textbf{Daily Water into the Pit}}{\left(\text{Area of the proposed pit (m2)}\right)}\right) / \ 24$$

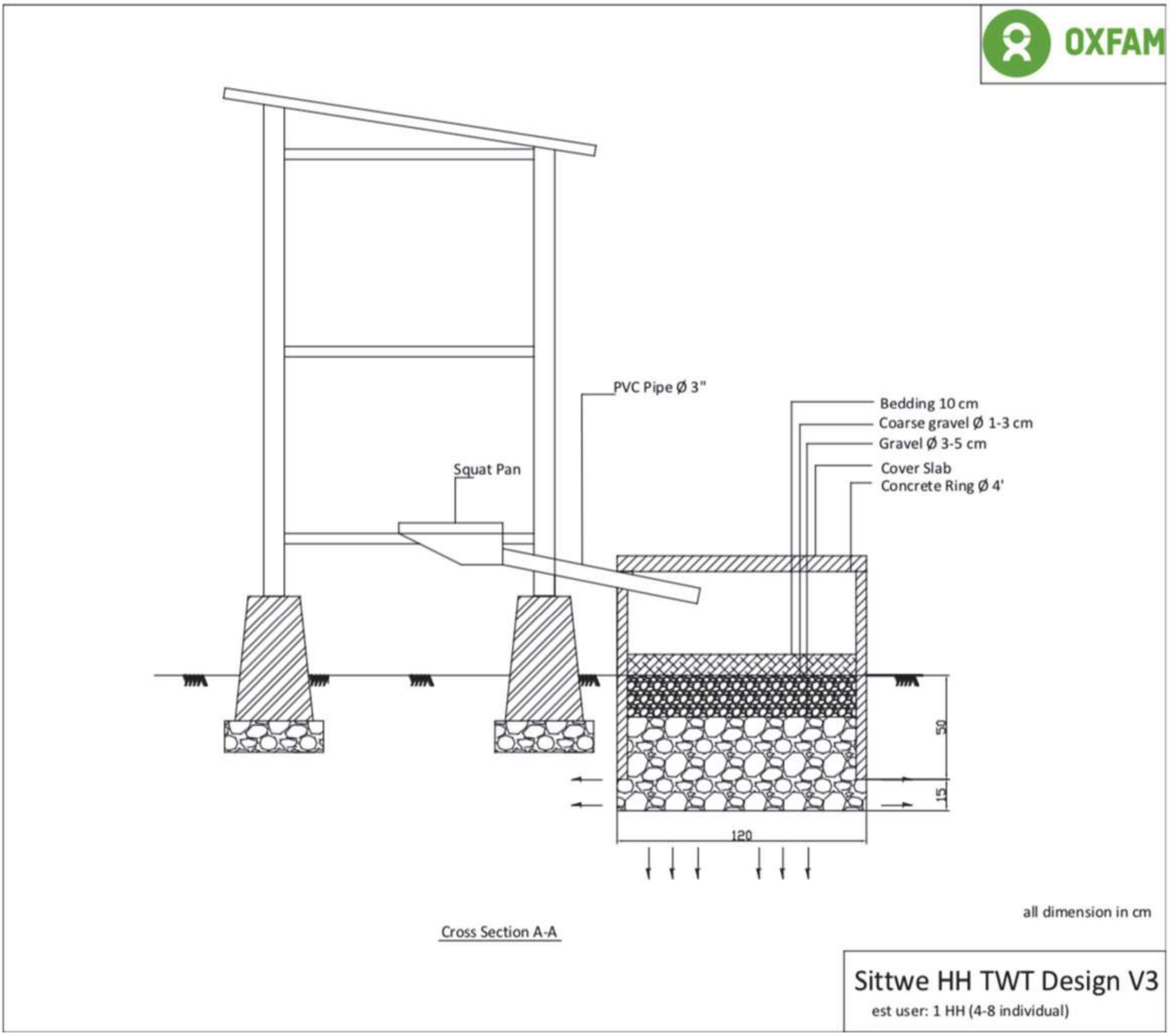
ANNEX – SAMPLE DESIGNS







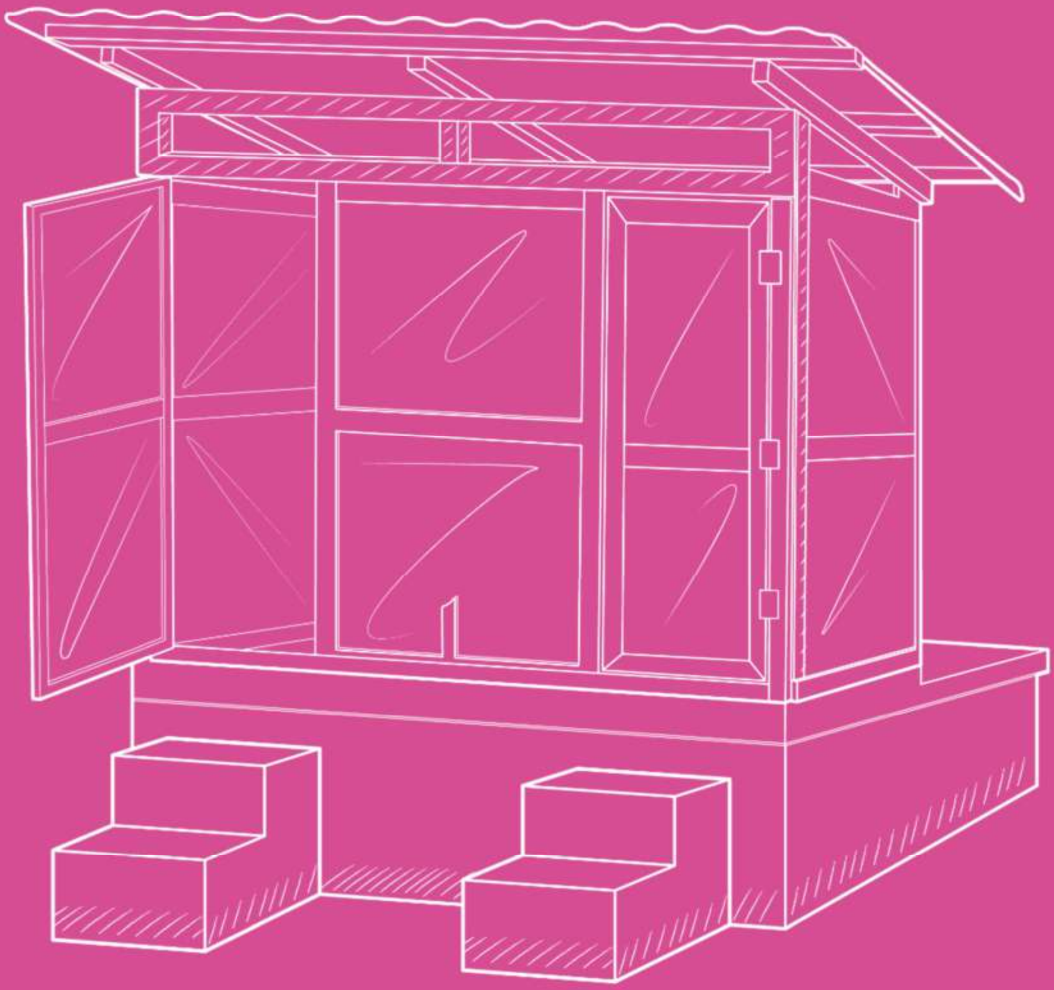
ANNEX – SAMPLE DESIGNS



Cross Section A-A

Sittwe HH TWT Design V3

est user: 1 HH (4-8 individual)



TIGER WORM TOILET MANUAL

Globally relevant learnings from Myanmar

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