# Sanitation Safety Planning

Applying the WHO methodology to SOIL's operations in Northern Haiti

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Date: October 2019

# SOIL
## Sanitation Safety Plan

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## Abbreviations

CBS: Container Based Sanitation

DINEPA: Direction Nationale de l'Eau Potable et de l'Assainissement - National Directorate for Drinking Water and Sanitation

EAWAG: Eidgenössische Anstalt für Wasserversorgung, Abwasserreinigung und Gewässerschutz - Swiss Federal Institute of Aquatic Science and Technology

HTH: High Test Hypochlorite

MDE: Ministère de l'Environnement - Ministry of the Environment

MPCE: Ministère de la Planification et de la Coopération Externe - Ministry of Planification and External Cooperation

MSPP: Ministère de la Santé Publique et de la Population - Ministry of Public Health and Population

MTPTC: Ministère des Travaux Publics, Transports et Communications - Ministry of Public Works, Transports and Communications

OREPA: Office Régional de l'Eau Potable et de l'Assainissement - Regional Office of Drinking Water and Sanitation

SOIL: Sustainable Organic Integrated Livelihoods

SSP: Sanitation Safety Plan

WHO: World Health Organization

## Executive Summary

Over the years, SOIL has developed a model to provide a safely managed sanitation service to densely populated communities in Haiti, using container-based sanitation. The objective of such an intervention is to reduce the risks to public health and the environment that unsafe sanitation practices create, and risk-based assessment methods such as Sanitation Safety Planning are a valuable tool to help evaluate the impact of SOIL's service, and also improve operations to mitigate risks as much as possible within the existing context. For this reason, the SOIL team was trained by the World Health Organization on the methodology of Sanitation Safety Planning, which was then implemented in SOIL's Northern Haiti operations.

SOIL worked in partnership with government representatives from the Department of Sanitation under the Ministry of Public Works, the Ministry of Public Health and the Ministry of the Environment to accomplish the following components of the Sanitation Safety Plan:

- Define clear objectives and system boundaries
- Break down operations into steps that can more easily be analyzed for potential risks.
- Identify and evaluate the risks to public health and the environment that exist in the current operations, and rank them based on probability and severity.
- Create a mitigation plan, that targets in priority the highest-ranking risks, the objective being to set up interventions, whether behavioral or through infrastructure development.
- Develop a calendar for mitigation solutions during the up-coming year, before the next yearly review that will aim to evaluate the impact of those mitigation measures and update the risk evaluation accordingly.

In SOIL's case, most mitigation measures proposed are behavioral and will require little to no investment. Once the measures are implemented, they can be evaluated periodically to ensure the objectives are met and the plan is still up to date.

# SOIL
## Sanitation Safety Plan

## Introduction

The use of container-based sanitation (CBS) systems is gaining traction as an innovative solution to increase access to sanitation, particularly in densely populated urban areas in countries with low sanitation coverage and waste treatment. In CBS systems, wastes are contained and collected in sealable containers, which is uniquely appropriate to dense urban settings because it takes up little space, does not require investment in infrastructure at the household level, and does not use scarce water resources for conveyance while still ensuring that all of the wastes are safely removed from the community and treated.


*Figure 1 Graphical depiction of SOIL's household sanitation service.*

Sustainable Organic Integrated Livelihoods (SOIL) is an organization providing a CBS service, called EkoLakay, to over 1,000 households in Haiti. SOIL (www.oursoil.org) is a US-based non-governmental organization working to promote ecological sanitation services in Haiti since 2006. SOIL has signed agreements with the Haitian Ministry of Planning and External Cooperation (MPCE) and the water and sanitation authority (DINEPA) which sits within the Ministry of Public Works, Transports and Communication (MTPTC). SOIL works closely with academic research partners to ensure that lessons learned in Haiti serve as a model for urban sanitation interventions around the world.

SOIL has co-authored over 10 peer reviewed articles on our work and fostered partnerships with a range of institutions including Stanford University, University of Hawaii, EAWAG (the Swiss Federal Institute of Aquatic Science and Technology), and the Ashoka and Schwab Foundations. These partners enable SOIL to rigorously measure impact, transparently share lessons learned, and quickly incorporate best practices.

In keeping with SOIL's commitment to public health and knowledge sharing, SOIL chose to do a Sanitation Safety Plan (SSP) following the training organized in September 2017 by the World Health Organization for CBS service providers.

# 1. Preparation for the Sanitation Safety Plan (SSP)

## 1.1 Priority area

SOIL currently operates 2 different sanitation services in the Cap Haitian area:

- a household toilet service named EkoLakay
- a commercial mobile toilet service for businesses, events, construction sites, etc... named EkoMobil

EkoLakay is SOIL's main sanitation program and it provides the most waste to the composting site. It is the program that will be scaled up to reach more households in the Cap Haitian area, and improve access to safely managed sanitation according to the SDGs. For this reason, SOIL will focus its SSP efforts on EkoLakay and the composting program that allows for treatment of the waste collected through both sanitation services.

## 1.2 Objective

Reduce the public health risks to people involved in SOIL's household sanitation service chain including users, workers, and members of the community where the service operates.

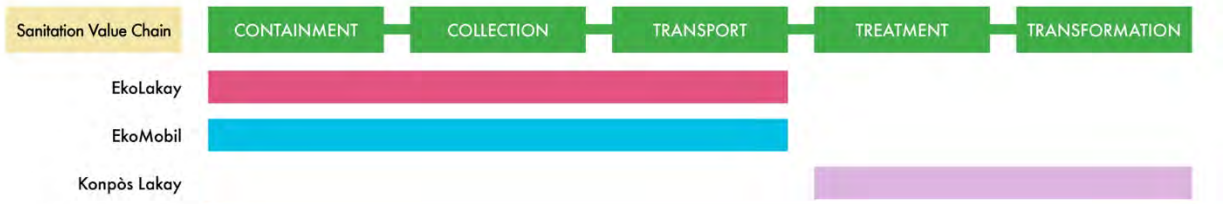



*Figure 2: Representation of SOIL's complete sanitation value chain. SOIL's household sanitation service, EkoLakay, and commercial sanitation service, EkoMobil, include the activities associated with containment, collection, and transport. Treatment and transformation are operated by SOIL's Konpòs Lakay program.*

## 1.3 System Boundary

The boundaries of the SSP system include everything within the EkoLakay household sanitation service chain and subsequent treatment and transformation of waste collected by the household sanitation service. This includes the construction of toilets, provision of the EkoLakay service to households in Cap-Haitian, the transport and treatment of waste at SOIL's Mouchinette composting site collected through the household service, and the reuse of compost.

*Table 1: Components/Activities within the SSP System Boundary*

| Components/Activities | Lead Organization |
|---|---|
| Toilet usage: EkoLakay clients use the EkoLakay toilet and manipulate the toilet to remove full containers and place empty containers. | SOIL |
| Household collection: every EkoLakay toilet is serviced weekly or twice-weekly by SOIL collection staff; transport is done using various collection vehicles including modified hand-carts and 3-wheelers. | |
| SOIL's flatbed truck transports containers from the depot to the treatment site once a week | |
| SOIL Konpòs Lakay composting site: all composting site components including equipment, tanks, water treatment, power/water supply, buildings, laboratory, and open spaces. | |
| The communities that live in the neighborhoods where EkoLakay clients live and where compost is used as a SOIL conditioner. | |
| The organizations and individuals that use SOIL compost as a soil conditioner. | |

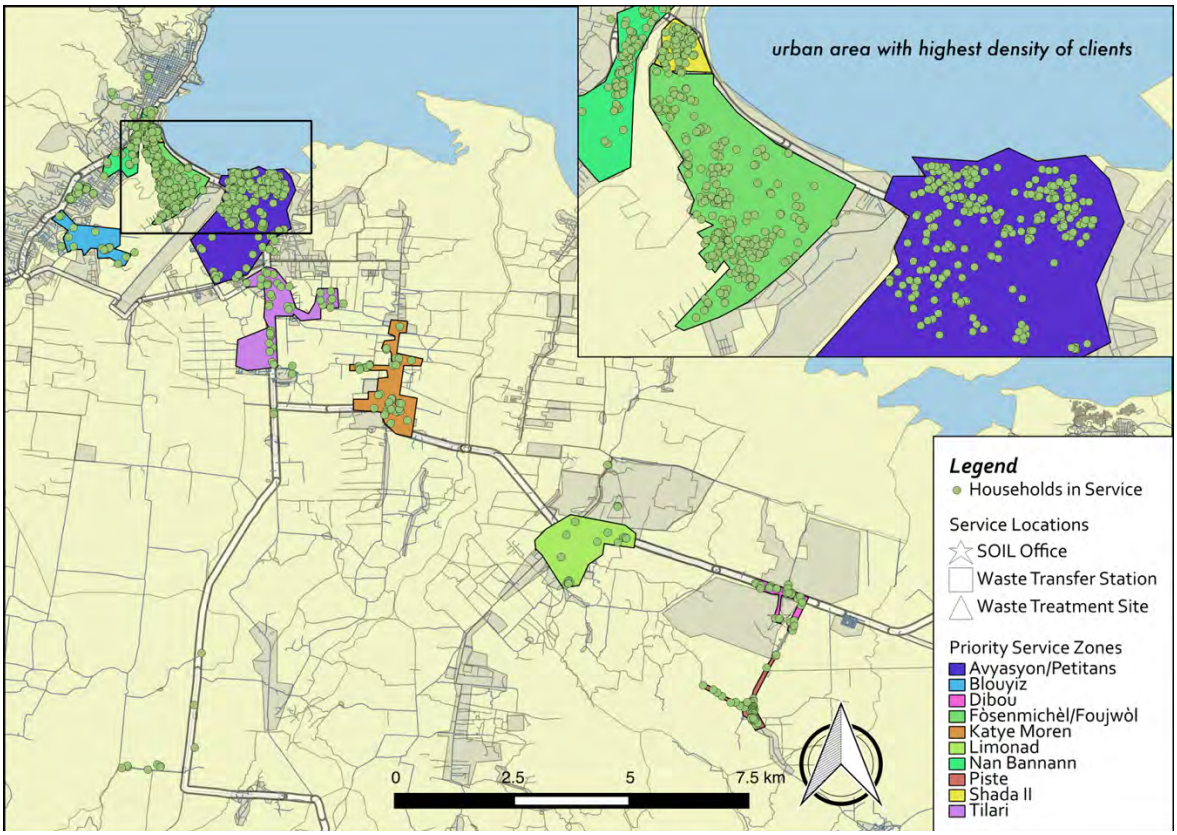



*Figure 3: Map of EkoLakay households and collection neighborhoods in Cap-Haitian*

Households that subscribe to the EkoLakay service are usually located in dense urban neighborhoods, highlighted in the above map (Figure 3). A number of those neighborhoods are flooding areas, located at or below sea level, putting them at risk every time it rains. They also have very high water tables due to the proximity to the shore. Few paved roads exist in those areas, with narrow corridors and dirt alleys instead.

The northern Haiti composting site is situated amongst agricultural and livestock land approximately 11km South-East of the Cap-Haitian International Airport, and 4km North-East of the town of Limonade, in the Department du Nord, in the Republic of Haiti.

The site has a surface area of 8500m2 with approximate dimensions 160m (East to West) by 70m (North to South). The site's GPS coordinates. are 19°40'39.30"N, 72° 6'51.02"O. The site elevation is approximately 15 meters above sea level.

The land features immediately next to the SOIL compost site are:

- To the West.

Directly to the West are small (under one hectare) plots of land used for cattle production and subsistence farming. Beyond these plots, 500m to the western boundary of the site, is a gravel road.

- To the East.

Directly to the East, a waste recycling facility is being built to service Cap Haitian, Quartier Morin and Limonade. Further East are small (under one hectare) plots of land used for cattle production and subsistence farming. These plots continue uninterrupted towards the East for many kilometers.

- To the North.

Directly to the North are small (under one hectare) plots of land used for cattle production and subsistence farming. Beyond these plots, 1000m to the northern boundary of the site, is a gravel road. The Atlantic Ocean is located approximately 6km to the North of the SOIL site.

- To the South.

Directly to the South are small (under one hectare) plots of land used for cattle production and subsistence farming. Beyond these plots, 650m to the western boundary of the site, is a tarmac road ("Route Nationale") with residential properties that are part of Limonade village.

## 1.4 SSP team

The SSP Core Team is composed of SOIL employees: they organize the meetings with the other stakeholders, lead the research and produce the necessary documents. Julie Jeliazovski (Program Advisor) is leading the team, with support from Romel Toussaint (Senior Manager for Cap Haitian), Erinold Frédéric (EkoLakay Manager) and Job Etienne (Waste Treatment Manager).
The SSP Core Team shall undertake the development of the SSP and the initial implementation and monitoring. They will invite primary stakeholders in the sanitation chain to participate in relevant meetings.

*Table 2: Primary stakeholders from the public sector*

| Representatives of | Main role in SSP |
|---|---|
| DINEPA (Haiti's national water and sanitation authority) and OREPA (Haiti's regional water and sanitation authority) | Support communication with the national government.<br>Participate in trainings and surveillance of activities.<br>Advise on technical matters.<br>Advise SOIL on laws and regulations that fall under their department and inform SOIL of the national strategy for sanitation. |
| MSPP (Haitian Ministry of Public Health) | Enlighten the community on the importance of the EkoLakay service and public health.<br>Provide feedback on risk mitigation from a public health standpoint.<br>Advise SOIL on laws and regulations that fall under their Ministry and inform SOIL of the national strategy for public health as it relates to SOIL's services.<br>Participate in trainings and surveillance of activities.<br>Provide epidemiological surveillance support. |
| MDE (Haitian Ministry of the Environment) | Advise on the treatment and reuse of wastewater.<br>Provide feedback on risk mitigation from an environmental standpoint.<br>Advise SOIL on laws and regulations that fall under their Ministry and inform SOIL of the national strategy for the environment as it relates to SOIL's services.<br>Participate in trainings and surveillance of activities |

## 2. Description of the sanitation chain

### 2.1 System map

In order to facilitate understanding of the operations under the scope of this Sanitation Safety Plan, the team designed a flow chart detailing activities and waste flows along with a step-by-step description that includes some quantitative data and photos.

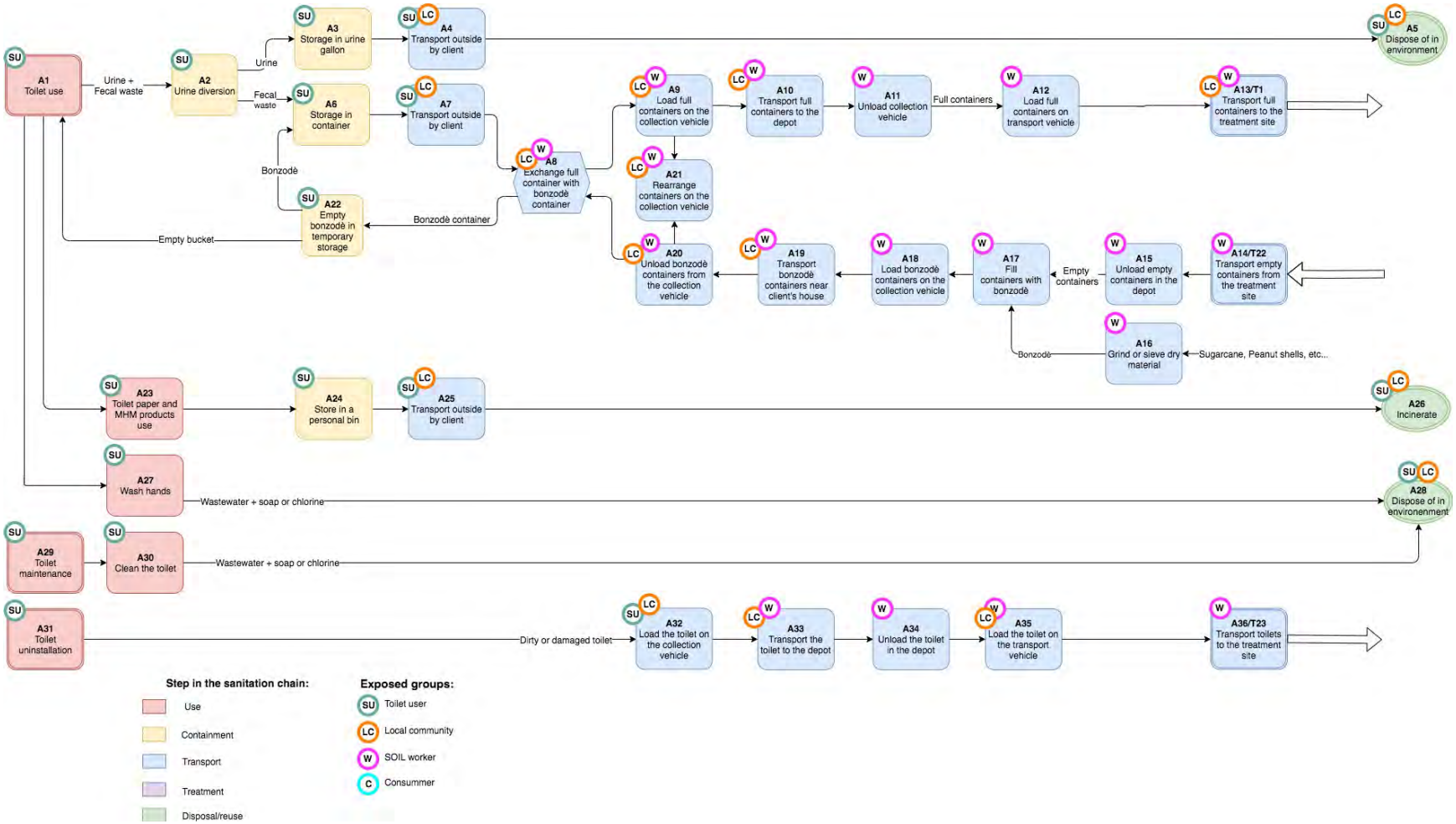



*Figure 4: Map of the EkoLakay activities*

A1: Toilet use

Based on collected data from August 2018, there is an average of 5.6 users per toilet. They can be families with children, elderly people or handicapped people. There is an estimated 14% of under-5 children.

*Figure 5: views of the EkoLakay urine-diversion toilet*

A2: Urine diversion

The urine diversion system allows for urine to not be mixed with feces. Both waste streams are collected in different containers inside the toilet structure.

A3: Store in urine gallon
A 1-gallon plastic jug allows users to store urine before disposal.


*Figure 6: the urine jug that goes in the front of the toilet*

A4: Transport outside by client
SOIL does not collect urine from clients, they have to transport and discard it individually. They usually take it outside, and we recommend that they do so on a daily basis to avoid bad smells.

A5: Dispose of in the environment
In a healthy human, urine is not contaminated with pathogens. For this reason, clients dump the urine in nearby canals without fear of disease. In addition, it is common practice for men to urinate outside.

A6: Store in sealable container
The feces and dry covering material are stored in a 5-gallon plastic sealable container identified with the EkoLakay logo. Clients have a few empty containers on reserve so they can remove and store full containers immediately without having to wait for collection day.

*Figure 7: the EkoLakay container that collects feces*

A7: Transport outside by client
On collection day, once a week, clients bring their full containers(s) outside their door to meet the collector.

A8: Exchange full container with bonzodè container
The collector takes the full containers and gives an equal number of clean containers containing bonzodè. The client doesn't need to be present for the exchange, they could leave the containers on their doorstep. On average, 7 containers are collected per month and per household.


*Figure 8: the collectors gives a clean container to the client in exchange for a container full of waste*

A9: Load full containers on the collection vehicle
The full containers are placed on the collection vehicle in the spots left empty by the clean containers given to the client. This collection vehicle can be a modified handcart or 3-wheel motorcycle with a specially designed back.

*Figure 9: one of the 2 types of collection vehicles is an improved wheelbarrow*

A10: Transport full containers to the depot
Once the collectors either finished the collection route or have no clean containers left, they go back to the depot to drop off the full containers.

*Figure 10: full containers are stored at the depot before they can be taken to the treatment site*

A11: Unload collection vehicle
The full containers are unloaded into the depot, stored safely and they then wait until they can be taken to the treatment site.

A12: Load full containers on transport vehicle
All the full containers are loaded on a bigger vehicle in order to optimize transport. This vehicle can transport around 500 containers.


*Figure 11: the "poop mobile" transports containers between the depot and the treatment site*

A13/T1: Transport full containers to the treatment site
The truck full of containers is taken to the treatment site approximately 11km away on the national road.

A14/T22: Transport empty containers from the treatment site
After being washed and disinfected at the treatment site, the containers (empty) are returned to the depot.

A15: Unload bonzodè containers in the depot
Empty containers are unloaded and stored in an area of the depot separate from where the containers full of waste wait for transportation.

A16: Grind or sieve dry material
Depending on the kind of dry material used to prepare bonzodè, it can be ground in a hammermill or sieved manually in order to reduce the particle size and provide ideal waste coverage when used in the toilet.

A17: Fill containers with bonzodè
Clean empty containers are filled completely with prepared bonzodè, and partially closed to avoid spillage but allow for air flow in order to avoid fermentation.

*Figure 12: generally, bonzodè is made of peanut shells and sugarcane waste*

A18: Load bonzodè containers on the collection vehicle
Containers full of bonzodè are then loaded on a collection vehicle in order to be delivered to clients.

A19: Transport bonzodè containers near client's house
Each collection vehicle follows a given collection route that stops by a number of clients' houses.

*Figure 13: a collector services a client with a 3-wheeler*

A20: Unload bonzodè containers from collection vehicle
At each house, the collectors unload the necessary number of containers from the vehicle in order to give to the client.

A21: Rearrange containers on the collection vehicle
To facilitate container storage and distribution, they are regularly rearranged so that clean containers are at the front, where the collector can reach them more easily.

A22: Empty bonzodè in temporary storage
After receiving clean containers, the client can empty the bonzodè into a temporary storage such as another container, or a rice bag.

*Figure 14: a rice bag to store bonzodè, a bin with a lid for toilet paper and MHM products, and soap for handwashing*

A23: Toilet paper and MHM products use
Toilet paper and menstrual hygiene products cannot be discarded inside the toilet.

A24: Store in a personal bin
SOIL recommends that clients use a small bin to collect toilet paper and other wastes produced when using the toilet. The bin should ideally have a lid to prevent flies and other vectors from entering.

A25: Transport outside by client
Regularly, the clients have to empty the bin. For this, they take it outside their home.

A26: Incinerate
Solid waste management is almost non-existent in Haiti, so SOIL recommends that clients burn the trash from their toilet bin to ensure that pathogens do not spread in the community.

A27: Wash hands
It is recommended that toilet users wash their hands with soap every time they use the toilet.

*Figure 15: handwashing can be difficult when there is no running water*

A28: Dispose of in the environment
As few houses are equipped with taps and drains, washing water is most of the time dumped outside the house in a canal.

A29: Toilet Maintenance
As with any type of toilet, EkoLakay toilets have to be maintained by the user for optimal use.

A30: Toilet cleaning
SOIL recommends that clients use chlorinated water to wash the toilet (seat and lid included) and that they regularly wash the reusable urine jug as well.

A31: Toilet uninstallation
There are several reasons a toilet can be uninstalled:

- the toilet is damaged, so it needs to be repaired and the client needs a new one
- the client wishes to leave the service, so the toilet is removed and might be reused for another client
- the client accumulated excessive debt (over 3 months) so the contract is broken and the toilet is removed.

A32: Load the toilet on collection vehicle
The uninstalled toilet is loaded on the collection vehicle, with any remaining containers if the contract was broken.

A33: Transport the toilet to the depot
The uninstalled toilet is taken to the same depot as the full containers.

A34: Unload the toilet in the depot
The toilet is unloaded to wait for transport to the treatment site where it will be washed.

A35: Load the toilet on the transport vehicle
When the larger vehicle comes to get the full containers, it also takes the uninstalled toilets in order to bring them to the treatment site.

A36/T23: Transport toilets to the treatment site
Toilets are taken to the treatment site to be washed and disinfected before they can be repaired or discarded.

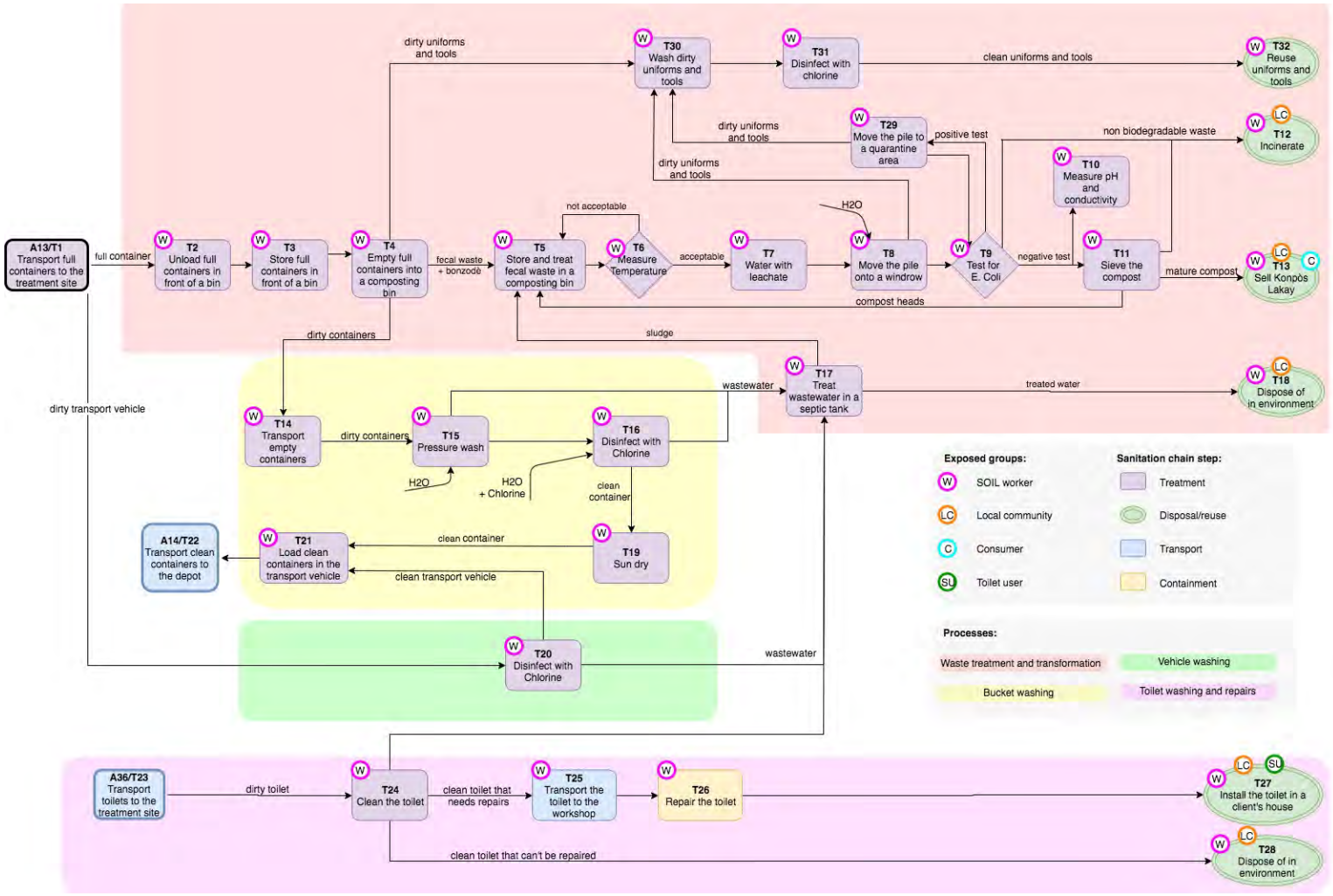



*Figure 16: Map of the composting activities*

T1: Transport full containers to the treatment site
The EkoLakay program brings containers full of waste to the treatment site using a truck with a capacity of approximately 500 containers.

T2: Unload full containers in front of a bin
When the containers arrive on the composting site, they are unloaded from the transport vehicle in front of a bin. The team grabs them one by one to pile them near their future emptying place. On average, 520 drums (15 gallons) and 7250 containers (5 gallons) were received at the site each month in 2018. No more drums will be received as of June 2019 as the humanitarian sanitation program has been closed.

T3: Store full containers in front of a bin
The sealed containers can await dumping for up to a few days after they have been unloaded, depending on the schedule at the composting site.

*Figure 17: containers awaiting dumping at the composting site*

T4: Empty full containers into a composting bin
A team of workers organizes a chain: 1 person opens containers with the special key, 1 person gives the open containers to those emptying them in the bin. Once emptied, the container is closed again and placed on the ground or in a special wheelbarrow until washing.

*Figure 18: dumping containers at the composting site*

T5: Store and treat fecal waste in a composting bin
Once the 12m³ bin is full, it is closed with a layer of sugarcane bagasse to reduce vector access and a screen is lowered on top of the bin. The material is stored for at least 2 months, and it is watered after a month using recycled leachate or water. It takes between 2 to 10 days to fill a bin, with an average 1240 5-gallon containers per bin (average over 212 piles).

*Figure 19: covering a pile of waste to protect it against vectors*

T6: Measure temperature
Temperature is measured in the piles for 8 consecutive days after closing the bin, in 3 different locations and at 2 different depths. It has to reach a minimum of 122 degrees Fahrenheit for 7 consecutive days according to the WHO guidelines in order to ensure pathogen die-off.

*Figure 20: thermometer measuring temperature in a pile of waste*

T7: Water with leachate
Leachate from a pile is recycled into that pile to maintain humidity to acceptable levels.

T8: Move the pile onto a windrow
Once the pile is 2.5 months old and the temperatures were satisfying, it can be moved onto a turning platform where it will start the maturation process for the next 4 to 5 months. The pile is turned once a month and watered when necessary.

*Figure 21: turning a pile of waste to increase decomposing rate*

T9: Test for *E. Coli*

When the pile reaches maturity, it is tested for *E. Coli* to guarantee the quality of Konpòs Lakay. The pile is considered "negative" if the *E. Coli* concentration is ≤1MPN/100mL, "positive" otherwise. Only negative piles can go further in the process.

*Figure 22: sampling a pile to test for pathogens*

*Figure 23: testing a pile to ensure pathogen die-off*

T10: Measure pH and conductivity

To evaluate the agricultural quality of Konpòs Lakay, each batch is tested for pH and electrical conductivity (E.C.). Acceptable pH ranges between 6 and 8, while E.C. has to be lower than 10mS/cm.

T11: Sieve the compost

Before being sold, Konpòs Lakay is sieved to remove any big particles and pieces of non-biodegradable waste that were dumped in the containers by the clients.

*Figure 24: sieving mature compost to remove undesirable particles and solids*

T12: Incinerate non-biodegradable waste
Due to the absence of a waste management system in the country, burning non-biodegradable waste is the easiest and safest way to eliminate it.

T13: Sell Konpòs Lakay
Compost is sold in bags or in bulk, to a wide range of clients: individuals, farmers, businesses, NGOs, etc... 99 metric tons of compost were produced in 2018.


*Figure 25: bags of compost ready for sale*

T14: Transport empty containers
After being emptied in a bin, the containers are loaded on a modified wheelbarrow and transported to the washing area, then unloaded on the concrete slab where they will be washed.

*Figure 26: pushing a cart full of dirty containers toward the washing area*

T15: Pressure wash the containers
Workers wearing specific waterproof equipment use pressure washers to remove all solids from the containers and lids.

*Figure 27: pressure washing dirty containers*

T16: Disinfect with chlorine

Once all solids are removed from the containers and lids, they are submerged in a heavily chlorinated solution for disinfection. Concentration in the bath has to be at least 0.2% chlorine, and the containers and lids need to remain in the bath for at least 1 minute.

*Figure 28: disinfecting containers in a chlorine bath*

T17: Treat wastewater in a septic tank

All the wastewater produced on the composting site is sent to a septic tank for primary treatment. It is a 3-chamber tank.

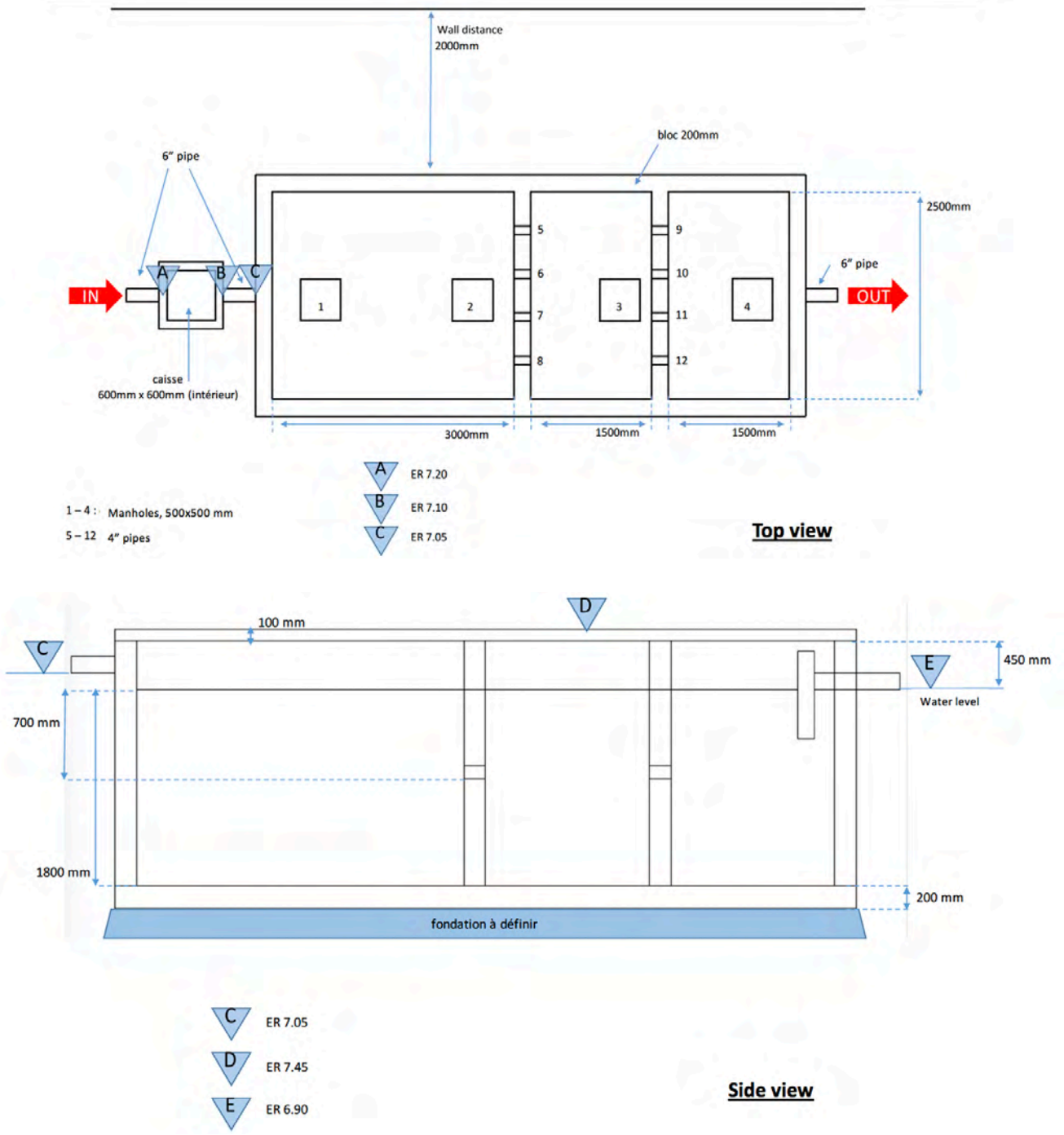



*Figure 29: detailed drawing of the septic tank, top and side view*

T18: Dispose of treated wastewater in the environment
The treated wastewater is released in the environment through a soak away pit. A planted leach field is currently under construction.

T19: Sun dry clean containers
After disinfection, the containers are placed on a clean concrete slab to dry in the sun, which acts as a secondary disinfection thanks to UV rays.

*Figure 30: sun drying disinfected containers*

T20: Disinfect vehicles with chlorine
All vehicles driving through the "red zone" on the composting site have to undergo a disinfection step before they can cross back into the "green zone". Chlorine concentration has to be at least 0.2%.

T21: Load empty containers on a transport vehicle
The disinfected containers are loaded on a transport vehicle in order to be transported away from the treatment site.

T22: Transport clean containers to the depot
The containers are transferred to the EkoLakay depot where they will be filled with bonzodè.

T23: Transport toilet to the treatment site
When uninstalled, used toilets are transferred to the treatment site before anything else.

T24: Clean the toilet
Once uninstalled, a toilet needs to be cleaned and disinfected before it can be either reused, repaired, or disposed of. Toilets are cleaned in the same way as containers, first with water to remove all solids then with chlorine for disinfection.

T25: Transport toilets to the workshop
The toilets that need repairs are taken to the toilet workshop (outside the composting site) in order to be fixed.

T26: Repair toilets
The toilets that can be fixed are repaired before they can be reused.

T27: Install a toilet in a client's house
If a toilet has been repaired, it can be rented to a new client.

T28: Dispose of an old toilet in the environment
Toilets that cannot be repaired are discarded. Sometimes they are used as flower pots in the SOIL offices, otherwise they can be broken down and the concrete used as backfill for construction.

T29: Move the pile to a quarantine area
If a pile tests positive for *E. Coli* after the maturation process, it is moved to a quarantine area in order to keep decomposing and not contaminate other piles. It will be tested again after one month. In case of a second positive test, the pile is then sent back to the bins to be mixed with fresh waste and restart the decomposing process. If it tests negative, it goes back to the normal process with sieving.

T30: Wash dirty uniforms and tools
Uniforms and tools must be washed after use before they can be reused.

T31: Disinfect with chlorine
According to the safety protocols, all uniforms and tools must be disinfected before reuse.

T32: Reuse uniforms and tools
Most of the equipment is reusable, SOIL avoids using disposable equipment.

## 2.2 Characterization of the waste fractions

The following are waste fractions at the household level:

- Urine, approximately 800mL per day = 292 L per year per person
- Excreta/fecal sludge (in combination with cover material and possibly inorganic material), 35 gallons per household and per month on average
- Toilet paper and menstrual hygiene products
- Greywater (from washing toilets and hands).

The following are waste fractions at the treatment site:

- Septic tank sludge
- Black water from container washing
- Greywater from showering and laundry
- Inorganics (mixed in with collected fecal sludge)
- Agricultural waste (added in to the treatment process)

## 2.3 Identify potential exposure groups

The five categories of potential exposure groups are sanitation users (SU), workers (W), local community (LC), compost users (CU) and consumers (CO). The exposure groups for individual processes are labeled in the system map above. The sanitation users include everyone that uses the toilets placed in EkoLakay client households: children, adult men and women, elderly people, handicapped people. Workers include SOIL staff that do container collection, transport, and operations at the waste treatment site. The local community includes everyone potentially impacted by operations of the sanitation service, waste treatment, and reuse of the final compost. The compost consumers are those purchasers and users of the compost produced at the waste treatment site.

## 2.4 Gather compliance and contextual information

A summary of key compliance and contextual information is presented below. Environmental and sanitation regulations in Haiti are scarce, which leads SOIL to follow the technical recommendations published by the national direction of water and sanitation (DINEPA) as well as the international WHO guidelines for environmental and public health protection in the sectors of sanitation and excreta reuse.

*Table 3: List of Haitian laws regarding sanitation*

1. Code de l'Urbanisme
- Décret-Loi du 22 Juillet 1937 : Urbanisme / Gestion ordures ménagères
- Loi du 29 mai 1963 : Eaux Usées et Assainissement

*Extrait :*

> Article 38- Toute propriété habitée quelle qu'en soit l'importance doit être pourvue d'un cabinet d'aisance aménagé dans une pièce éclairée et aérée directement.
> Article 43- Il est interdit de déverser dans les cours

2. Code de l'Hygiène
- Loi du 24 Février 1919 : Service National d'Hygiène Publique
- Loi du 5 Juin 1942 et son Arrêté d'application du 4 Juillet 1942 : Officiers sanitaires/ contravention à la Santé Publique
- Arrêté du 12 Avril 1919 : Règlements Sanitaires

*Extrait :*

> Article 1- Par 20.- Toute maison d'habitation ou tout établissement commercial ou d'affaires en général, doit être pourvu de latrines ou fosses d'aisances qui devront, tant sous le rapport de leur emplacement qu'à tous les autres points de vue, satisfaire aux

3. Code Rural François Duvalier - 1960
- Loi No XV (Hygiène rurale)

*Extrait :*

> Article297.- Il est interdit d'évacuer ou de jeter des excréments humains dans les cours d'eau, sources, étangs, réservoirs, mares ou à proximité, aussi bien que dans les cours, jardins, champs, bosquets,

4. Loi du 19 Septembre 1937
- Attribution des Communes (Services d'Utilité Publique)

5. Loi du 13 Juillet 1978
- Réorganisation départementale TPTC

6. Arrêté Présidentiel du 21 Avril 1983
- Délimitation zone d'intervention (SMCRS) / Truitier : zone de traitement et de décharge

### 2.5 Validate the system description

Validation of the system description included discussion with the SOIL operational team, and a review of the accompanying narrative with the SOIL leadership team.

## 3. Risk Analysis

The tables below are an excerpt of the full tables available in appendix. They show only the highest-ranking risks for EkoLakay and Composting.

### 3.1 EkoLakay

| | | | | | | | Risk Evaluation | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Step** | **Description** | **Hazardous Event** | **Danger** | **Exposure Ways** | **Exposure Groups** | **Controls in place** | **Probability (1 to 5)** | **Severity (1 to 16)** | **Risk (L x S)** | **Risk Level** |
| A6 | Storage in container | A full container is waiting for collection day, it's not well closed, vectors have access to fresh waste and carry pathogens within the house | Biological | Vector | Toilet user, local community | Training on closing containers | 4 | 4 | 16 | HIGH |
| A7 | Transport outside by client | Container handle breaks under the weight of a full container, container drops to the ground: if the container breaks, fresh waste will be released and contaminate the environment | Biological | Ingestion after contact with wastewater or excreta | Toilet user, local community | | 2 | 8 | 16 | HIGH |
| A9 | Load containers on collection | A bonzodè container is stored next to a dirty full container in the collection vehicle, contamination is shared and reaches the household | Biological | Ingestion after contact with wastewater or excreta | Toilet user, local community | | 2 | 8 | 16 | HIGH |
| A10 | Transport full containers to depot | Vehicle gets into an accident, containers spill on the road | Biological | Ingestion of contaminated water | Local community, workers | Recruitment of qualified drivers, emergency protocols in case of spillage | 2 | 8 | 16 | HIGH |
| A10 | Transport full containers to depot | A container is not secure on the collection vehicle, falls off during transport and spills contamination in the community | Biological | Ingestion of contaminated water | Local community | | 2 | 8 | 16 | HIGH |

## 3.2 Composting

| | | | | | | | Risk Evaluation | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Step** | **Description** | **Hazardous Event** | **Danger** | **Exposure Ways** | **Exposure Groups** | **Controls in place** | **Probability (1 to 5)** | **Severity (1 to 16)** | **Risk (L x S)** | **Risk Level** |
| T4 | Empty full containers in a compost bin | A worker needs to drink, goes out into the green zone with a dirty uniform on, dropping contamination in the environment and near the drinking water station | Biological | Ingestion of contaminated water | Workers | | 5 | 4 | 20 | HIGH |
| T4 | Empty full containers in a compost bin | Workers are done emptying buckets, they go in the changings rooms cabinet to grab clean towels, and drop contamination in the clean area and near their clean clothes | Biological | Ingestion after contact with wastewater or excreta | Local community, workers | | 5 | 4 | 20 | HIGH |
| T29 | Washing dirty clothes and tools | Dirty uniforms sit on the floor in the washing area or in an open drum, vectors can reach | Biological | Vector | Local community, workers | According to the protocol, dirty uniforms must be store in a closed container, but it's not well respected | 5 | 4 | 20 | HIGH |
| - | Other | Construction: construction workers go between red and green zones carelessly, they transfer contamination in the future green zone | Biological | Contamination of the environment | | | 5 | 4 | 20 | HIGH |

## 4. Mitigation measures

For the highest risks evaluated in both EkoLakay and Composting operations, the team discussed ways to reduce them and a calendar for implementation has been prepared as follows.

### 4.1 EkoLakay

| Risk | Risk Level | Mitigation measure | Proposed Date | Comments |
|---|---|---|---|---|
| *" A full bucket is waiting for collection day, it's not well closed, vectors have access to fresh waste and carry"* | *16* | All clients receive a training on how to close the buckets, but it seems insufficient as we find a lot of buckets that are not well closed when they reach the treatment site. We need to ask collectors to check each bucket individually at the moment of collections. They can then be checked a second time at the transfer station. | 4/30/20 | This is an issue of bucket/lid compatibility, which should be resolved with the next bucket order. |
| *" A bonzodè bucket is stored next to a dirty full bucket in the collection vehicle, contamination is shared and reaches the household"* | *16* | We need to reduce the number of dirty buckets that are collected: 1- train clients on not leaving a dirty bucket in their house or on the street 2- equip collectors so they can wipe and disinfect dirty buckets | 6/30/20 | to be connected with HCD project |
| *" Vehicle gets into an accident, buckets spill on the road."* | *16* | It's hard to prevent a bucket from opening in case of an accident, but we can reduce the likelihood of accidents happening: 1- Well trained drivers, 2- Speed limits based on the type of vehicle | 1/31/20 | We can probably set up the speed limits by end of January |
| *" A bucket is not secure on the collection vehicle, falls off during transport and spills contamination in the community "* | *16* | We need to limit the number of buckets transported per vehicle based on specific capacity. For this, we can have transport protocol. Once we control the number of buckets on a vehicle, we need to make sure each of those buckets is well positioned and potentially attach them so they can't fall. | 3/31/20 | |
| *" A full bucket is waiting for collection day, it's dirty on the outside, vectors have access to fresh waste and carry pathogens within the house"* | *12* | If we get a dirty bucket from a client, we can give them a reminder that it's important to keep the buckets clean. If it happens multiple times in the same household, we can organize a hygiene visit to identify the source of the problem | 3/31/20 | |

| | | | | |
|---|---|---|---|---|
| *" A broken bucket allows vectors to access fresh waste and spread contamination"* | *12* | We need to identify when and why buckets break to reduce this risk, because we already remove broken buckets and lids at 2 different points in the service: after dumping/washing at the treatment site, and at the transfer station when filling with bonzodè. | 4/30/20 | |
| *" Children can reach in the bucket and touch the fresh waste (unlike more traditional sanitation solutions)"* | *8* | [we're considering giving a special message during the initial training with families that have young children] | 3/31/20 | |
| *" On collection day, a full bucket sits outside for a long time before the collector arrives, a person not knowing what it contains steals the bucket."* | *8* | Following advice from the Ministry of Public Health, we might add a logo on the buckets that says water or food should not be stored in the buckets. | 4/30/20 | with the next order of buckets |
| *" The collector handles a dirty bucket before handling a bonzodè bucket, with the same gloves. There can be cross contamination. "* | *8* | | 3/31/20 | [We need to find a way for the collector to efficiently disinfect his gloves regularly without impacting operations too much] |

# SOIL
## Sanitation Safety Plan
### 4.2 Composting

| Risk | Risk Level | Mitigation measure | Proposed Date | Comments |
|---|---|---|---|---|
| *" A worker needs to drink, goes out into the green zone with a dirty uniform on, dropping contamination in the environment and near the drinking water station."* | *20* | We're suggesting to create a transition zone, "orange zone" between the red and green zones, with a small storage cupboard where staff store their water bottles. Next to the cupboard is a handwashing station, compulsory before drinking. This way, workers don't have to go in the green zone to drink. This orange zone could be in the disinfection basin. | 12/15/19 | |
| *" Workers are done emptying buckets, they go in the changings rooms cabinet to grab clean towels, and drop contamination in the clean area and near their clean clothes."* | *20* | We found a very simple solution for this: before they start dumping, while they are still changing, the team has to prepare their towels and place them near the showers beforehand. Once they are done dumping they can go directly in the shower. | ASAP | This is more behavior change rather than technical, so we'll have to make sure the team actually does it |
| *" Dirty uniforms sit on the floor in the washing area or in an open drum, vectors can reach contamination and carry it away."* | *20* | The protocol already says that dirty clothes should be stored in a closed container until they are washed, but it is not applied. We just need to apply it. | 12/1/19 | We just need to make sure there's a lid for the dirty clothes container, and that someone closes it after showers. |
| *"Construction workers go between red and green zones carelessly, they transfer contamination in the future green zone"* | *20* | While building new bins and windrows, the workers have to cross between the red zone and the future green zone, without the possibility to disinfect their feet and hands. Instead we suggest considering all construction areas as temporary red zones, and have clear delimitations around them. Once construction is over, we can use lime to disinfect what needs to be green zones. | next time we build a composting unit | |
| *" Dumping creates aerosols that reach workers nose and mouth."* | *12* | The team doesn't always wear the masks properly, meaning they can breathe aerosols in. We need to ensure that masks are well worn to cover nose and mouth. We can maybe find better masks. | quarterly audits with objective to reach compliance by the end of fiscal year - 7/31/20 | This basically translates to more protocol audits to enforce proper PPE use - audits have to be followed by a report to the audited team so they know the outcomes and points of improvement |

| | | | | |
|---|---|---|---|---|
| *" Dumping creates dust that reaches piles in the green zone, the same shovel is used for those piles and piles already tested in the windrow, which might transfer contamination to finished compost."* | *12* | Tools used in one pile should be disinfected before being reused in a different pile. But the protocol isn't always well applied. We need to ensure that tools used to sieve finished (tested) piles are always clean to reduce cross contamination. | quarterly audits with objective to reach compliance by the end of fiscal year - 7/31/20 | We could also set up a weekly event at Mouchinette, maximum 5 minutes, to remind the team of one aspect of the protocols. |
| *" Workers get in contact with fresh waste while measuring temperature."* | *12* | When there's no dumping, it's easy to forget that the red zone can have pathogens. The worker measuring temperature can be exposed to contamination especially when reaching for the center of the pile. We need to ensure that the protocol is well followed, with appropriate equipment and no physical contact with the waste other than the thermometer. | quarterly audits with objective to reach compliance by the end of fiscal year - 7/31/20 | same as 5 |
| *" Pressured water sprays waste particles and wastewater onto the worker."* | *12* | Protective equipment is the most important thing here, but they need to be properly used in order to be efficient. We need to ensure that protocols are well followed, like for example closing the rain suit fully or hanging them correctly so they don't get damaged, using the full-face masks correctly, etc... | quarterly audits with objective to reach compliance by the end of fiscal year - 7/31/20 | same as 5 |
| *" Bucket lid is not well closed, or bucket is broken, and vectors can get in and out."* | *10* | We need to avoid receiving buckets at the treatment site that aren't well closed. Collectors need to check the buckets during collection and at the transfer station, because they can't be verified at the treatment site (receiving too many buckets at once). It's also a good way to reduce the risk all along the transport route, not just at the treatment site. | See EkoLakay | |
| " Buckets are poorly stacked, one or several fall and break, releasing waste in the environment" | *8* | We can set a maximum stacking height for buckets to reduce the risk of collapsing piles, but also ensuring that all buckets are well closed will increase stability. | 1/31/20 | I'd suggest setting 2 limits: one when buckets sit on the ground, and a lower limit when they're on the table |
| " Bucket transport vehicle picks up pathogens on its tires in the red zone, carries them out to the green zone and local community" | *8* | We suggest setting up a speed limit for vehicles going through the disinfection basins, so that tires have time to be disinfected properly. | 3/1/20 | |

| | | | | |
|---|---|---|---|---|
| " Worker gets in contact with contaminated waste while moving it" | 8 | The quarantine areas are currently in a sort of middle ground between the green and red zones. If we make them officially part of the red zone, workers will be more careful when working around those piles. | 12/31/19 | |
| " Vectors are able to get in contact with contaminated waste" | 8 | We need to find a way to cover those piles, in a similar way to fresh waste. | 6/1/20 | |
| " Worker accidentally touches a sharp object and gets injured (inorganic waste fraction removed while sieving)" | 8 | We need to encourage workers to never directly use their hands while sieving, only use the tools available (shovel, fork, etc... ) | 8/1/2020 dependent on Kreativ Konsum's work | Timeline will depend on KK's work, as changing the sieving process might reduce the risk |
| " Septic tank is full of sludge, wastewater doesn't get treated anymore and is released raw in the environment" | 8 | The tank is supposed to be desludged every 3 months, but we might add a monthly check of the sludge levels. | 1/31/20 | |

## 5. Review plan

This Sanitation Safety Plan is not a one-time document it is a continuing process to ensure risks are always managed as best as possible within SOIL's possibilities. For this reason, the efficiency of the mitigation measures needs to be regularly evaluated and the risks reassessed based on potential changes in operations or in the situation in the communities. This review should be done once a year, followed by updated risk tables as well as an updated report.

Review log:

| Version | Person in charge | Date |
|---|---|---|
| Original | Julie Jeliazovski | November 2019 |
| 1st Review | | *planned: October 2020* |
| 2nd Review | | *planned: October 2021* |
| | | |

## Conclusion

By looking for solutions to the sanitation crisis in Haiti, SOIL is developing systems that are designed to improve public health and the environment in the target communities. However, a systematic tool such as Sanitation Safety Planning is valuable to ensure that no new threats are created by SOIL's operations. The SSP will also help SOIL keep track of progress through time and reach more people with a safely managed sanitation system.

Working on the SSP for 2 years before finalizing this report has allowed SOIL's operational team to develop an increased understanding of the health and safety aspects of their work, by continuously analyzing routine activities and trying to improve them. It has been a challenge to match cost reduction objectives with health and safety concerns, but the team was able to find mitigation measures for the highest risks that require limited financial investment by focusing on behavioral interventions rather than infrastructure development. Next steps involve reviewing and updating the risk tables on a yearly basis to reevaluate risks based on changes in operations or environment, as well as working closely with the local and central government to promote risk-based assessment of sanitation services throughout the country.

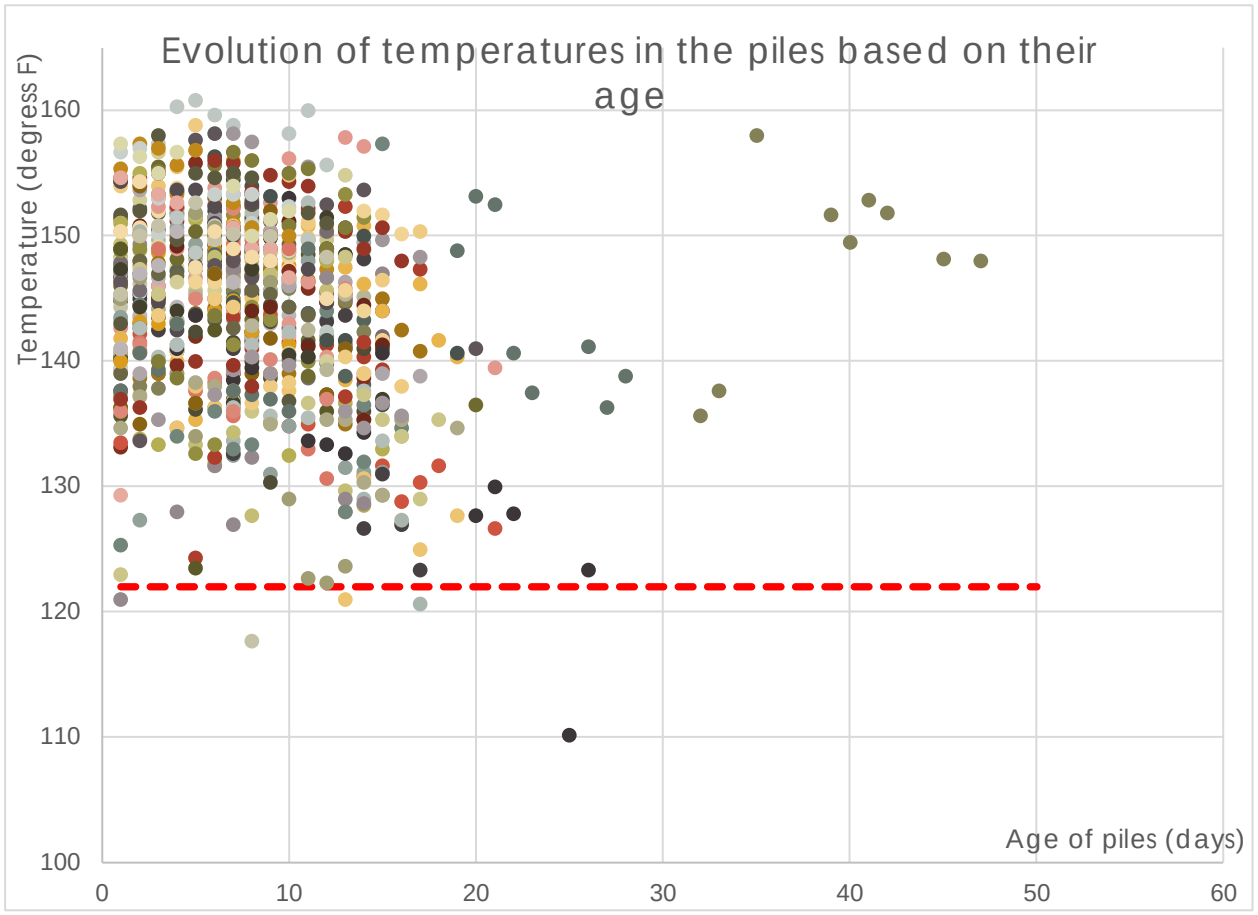
# Appendices

## Appendix 1: Historical temperature data in the compost piles

Our field team is tasked with measuring temperature in all the bins for at least 8 days, in order to ensure that our compost meets the WHO standards of 122°F for 7 consecutive days.

The data in the following graph corresponds to daily averages of 6 data points per pile, taken in 3 different locations and at 2 different depths.

As can be seen on the graph, only 5 of those daily data points were below the WHO standard ranging over 107 piles, which is about 1.5 year. It corresponds to only 0.52% of the data points, which is acceptable for our process, considering that we let the piles heat up for 2.5 months before turning them, and that each pile undergoes an overall process of at least 6 months concluded by an *E. Coli* test.




As an indication, the following graph shows the die-off rate of various pathogens based on temperature and exposure time. Enteric viruses and Ascaris eggs are the most resistant pathogens, but the WHO standard makes sure they are killed along with the other pathogens. A study conducted by the CDC in 2015 also shows the efficiency of SOIL's composting system to eliminate pathogens (Berendes et all, 2015)

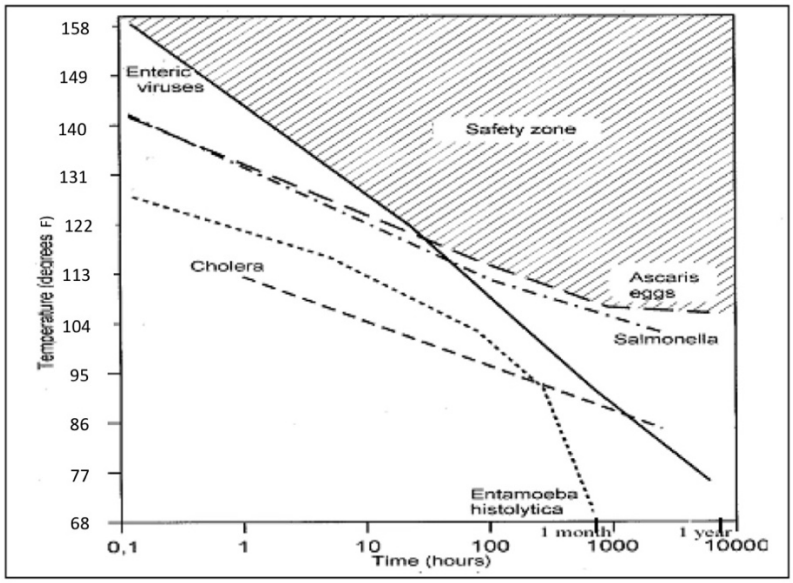



*Figure 31: Elimination of pathogens over time and temperature*

## Appendix 2: Historical E. Coli data in compost piles

As mentioned previously in the document, each pile gets tested for *E. Coli* when it reaches maturity. It should be noted that no pile with *E. Coli* continues in the normal process, they are all removed and treated separately until they test *E. Coli* free. A pile that tests positive to *E. Coli* twice is automatically recirculated into the fresh waste bins, but so far it has only happened twice.

| test E. Coli | 2018 |
|---|---|
| negative | 96 |
| positive | 11 |
| total | 107 |

| | |
|---|---|
| **% negative** | **89.7%** |
| **% positive** | **10.3%** |

It can be noticed that about 10% of the tests fail. The team is having difficulties identifying the reason behind those contaminated piles, as further research showed most of those the piles were pathogen free after 2.5 months of treatment. It means they were re contaminated during the maturation process. The team suspects the cats that live on the site, as they rid us of rodents but they cross freely between red and green zone all the time.

## Appendix 3: Container washing protocol

STANDARD OPERATIONS PROTOCOL

| CONTAINER WASHING | |
|---|---|
| Objective | Ensure that all dirty containers are washed in the reserved area, using a pressure washer, then disinfected with chlorinated water according to the disinfection protocol in order to protect both workers health and the environment. |
| Frame | This protocol must be followed after each dumping session. |
| Responsibility | The composting team is responsible for executing the protocol. The site supervisor is in charge of verifying the correct application of the protocol. |
| Necessary Equipment | • Gloves<br>• Overalls<br>• Boots<br>• Mask<br>• Pressure washer<br>• Chlorine (HTH) |

Activity 1: Before container washing

| Step | Action |
|---|---|
| 1 | Make sure that the water drain is not clogged. |
| 2 | The composting team must wear the full equipment: overalls, boots, mask and gloves. |
| 3 | Ensure that the hands washing fountains, the container disinfection tank and the tire disinfection tank are full of chlorinated water according to the disinfection protocol. |
| 4 | Make sure that all the dirty containers are organized in the washing area and closed with their lids. |

Activity 2: During container washing

| Step | Action |
|---|---|
| 5 | Use the pressure washer to wash the containers and lids thoroughly and remove all remaining solids. |
| 6 | Place the clean containers and lids in the disinfection tank. Leave them for at least one minute before taking them out. |
| 7 | Place the disinfected containers and lids on the drying bed to let them sundry. |
| 8 | Repeat steps 5 to 7 for each container and lid. |

Activity 3: After container washing

| Step | Action |
|---|---|
| 10 | Make sure the washing area and all tools that were used in the process are cleaned according to the disinfection protocol. |
| 11 | Make sure that each team member involved in washing cleans himself completely according to the disinfection protocol. |
| 12 | Store all the dirty overalls and protective equipment in a specific container so they can be disinfected appropriately later on, following the disinfection protocol. |
| 13 | Make sure all the clean containers and lids are stored in a clean area (hangar for example) |

## Appendix 4: Disinfection protocol

STANDARD OPERATIONS PROTOCOL

| DISINFECTION | |
|---|---|
| Objective | Make sure each person, equipment or vehicle entering and leaving the red zone is disinfection appropriately to avoid contamination of people or the environment. |
| Frame | This protocol applies to all people, equipment and vehicles leaving the site's red zone. |
| Responsibility | Each person entering the red zone and using one or more pieces of equipment in the zone is in charge of following this protocol. The site supervisor is in charge of verifying the correct application of the protocol. |
| Necessary Equipment | • Water<br>• HTH (65%)<br>• Mixing tool (stick)<br>} Chlorinated water<br>• Brush<br>• Pressure washer or hose<br>• Gloves |

Activity 1 : Preparation of the chlorinated solutions

| Step | Action |
|---|---|
| | I. Preparation of the Disinfection Tank solution (0.2 %) |
| 1 | Check if the tank is full and if chlorine has to be added.<br>If the tank is ready, go directly to « II. Preparation of the Hand Washing solution (0.05%)». If not, go to the next step. |
| 2 | Fill the tank with water (8 drums = 456 liters) |
| 3 | Wear gloves and add 1.4 kilo of HTH in the full tank. |
| 4 | Stir with a stick for at least 2 minutes to ensure complete dilution of the chlorine in water. |
| | II. Preparation of the Hand Washing solution (0.05%) |
| 5 | Check if the tank is full and if chlorine has to be added.<br>If the tank is ready, go directly to « II. Preparation of the Tire Disinfection Basin solution (0.05%)». If not, go to the next step. |
| 6 | Fill the tank with water (5 gallons) |
| 7 | Wear gloves and add 15 grams of HTH in the full tank. |
| 8 | Stir with a stick for at least 30 seconds to ensure complete dilution of the chlorine in water. |
| | III. Preparation of the Tire Disinfection Basin solution (0.05%) |
| 9 | Check if the basin if full and if chlorine has to be added.<br>If the basin is ready, go directly to « What do I need? ». If not, go to the next step. |
| 10 | Fill the basin by the main gate with 6 drums of water (342 liters).<br>Fill the basin by the carwash with 7 drums of water (399 liters). |
| 11 | Wear gloves and add:<br>- 263 grams of HTH in the basin by the main gate<br>- 307 grams of HTH in the basin by the carwash |
| 12 | Stir with a stick for at least 2 minutes to ensure complete dilution of the chlorine in water. |

What do I need?

- For disinfection of People, go to Activity 2
- For disinfection of Equipments and Tools, go to Activity 3
- For disinfection of Vehicules, go to Activity 4
- For disinfection of Clothing, go to Activity 5
- For disinfection of Surfaces, go to Activity 6

Activity 2 : Disinfection of People
Everyone has to disinfect themselves before leaving the red zone.

| Step | Action |
|---|---|
| 1 | Before leaving the red zone, each person has to rinse their shoes and hands with a 0.05% chlorinated water solution. |
| 2 | Anyone taking part in dumping has to take a shower and dispose of dirty work clothes in a specific container before it can be washed. The container needs to remain closed. |

Activity 3 : Disinfection of Equipment and Tools
All equipment and tools have to be disinfected before leaving the red zone or being used for another activity (in the red zone or anywhere else).

| Step | Action |
|---|---|
| 1 | After being used in the red zone, all equipment and tools have to be disinfected using a 0.2 % chlorinated water solution. |
| 2 | After washing, sundry the equipment. |
| 3 | After drying, store the equipment and tools in their usual place. |

Activity 4 : Disinfection of Vehicles
All vehicles have to be disinfected before leaving the red zone.

| Step | Action |
|---|---|
| 1 | Park the vehicle in the washing area (« car wash ») |
| 2 | Use a hose or a pressure washer to clean the vehicle with water. Ensure that all solids are removed. |
| 3 | If the vehicle was carrying contaminated matter (waste containers for example), disinfect the bed with a 0.2% chlorinated water solution. |
| 4 | When leaving the red zone, make sure that the vehicle drives through the tire disinfection basin. |

Activity 5 : Disinfection of Clothing

Each item of clothing worn during dumping must be stored in a specific sealed container before being washed and reused.

| Step | Action |
|---|---|
| 1 | Once dumping is finished, ensure that all worn items of clothing are stored in a specific sealed container |
| 2 | Soak the clothes in a 0.2% chlorinated water solution. |
| 3 | Spin, then wash with water and soap. |
| 4 | Sundry. |

Activity 6 : Disinfection of Surfaces

All surfaces used for « risky » activities (such as the washing area for example) must be disinfected after use.

| Step | Action |
|---|---|
| 1 | Use a hose or pressure washer to clean the chosen area with a 0.2% chlorinated water solution. Ensure that all solids are removed. |
| 2 | Sundry. |

## Appendix 5: Full risk analysis tables

see attached documents