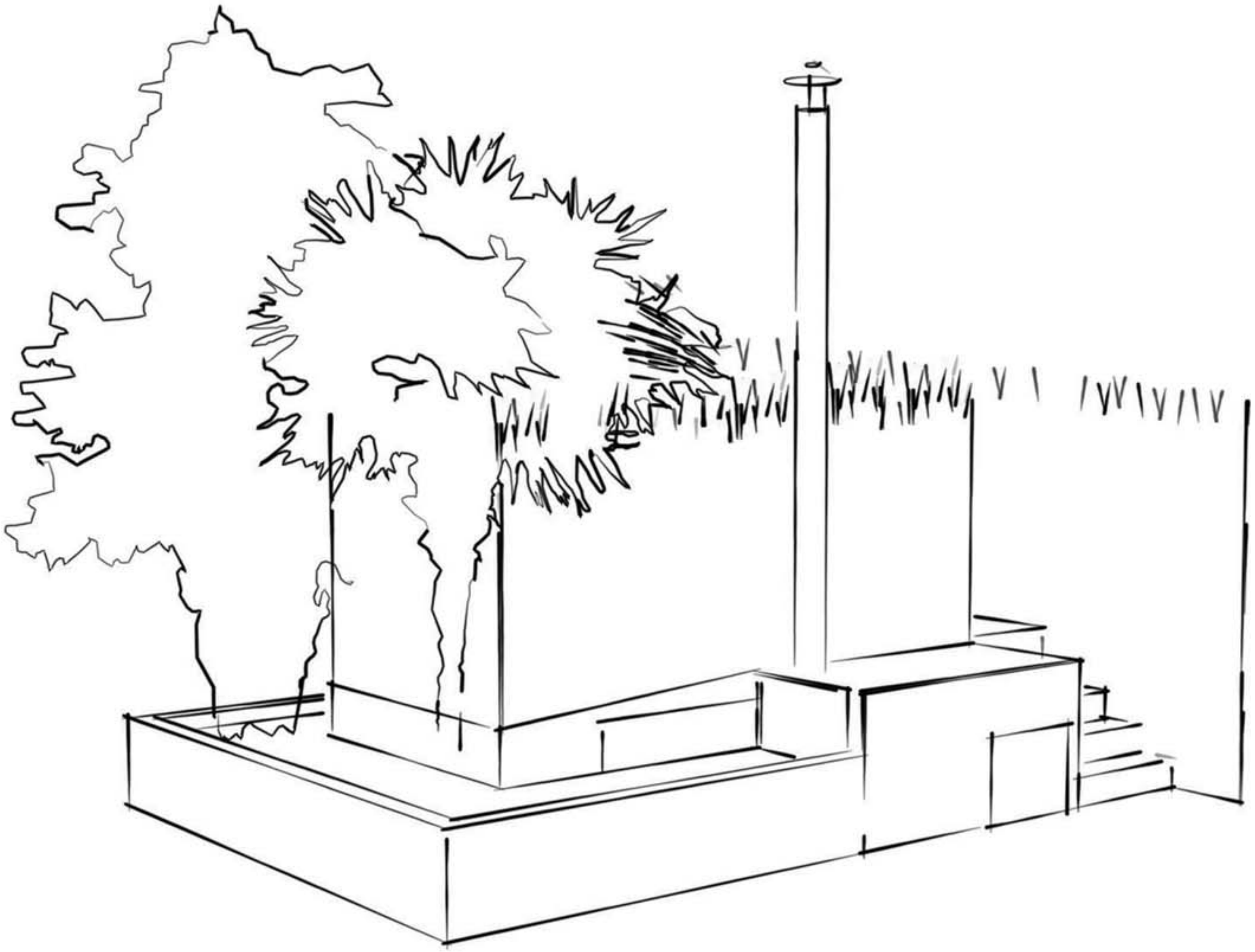
WASTE.LAND

LET WASTE MATTER



LARCH 599F
SUMMER 2016
SHIYANG HE

CONTENT

1 INTRODUCTION

Access to sanitation and clean water is one of the basic needs to be satisfied to achieve healthy living conditions and sustainable development in any community. However, even nowadays there are over 2.6 billion people in the world living a life without adequate sanitary facility or safe water supply (Thomas al., 2013). The lack of such fundamental municipal services has been proven to result in the prevailing of many water-related diseases which regulaly occur in underdeveloped regions, including diarrhea, typhoid and other notorious diseases spread in water, or water-related parasitic infections such as malaria, schistosomiasis and so on.

This issue is particularly severe in rural areas of Tanzania, where 76% of the villagers use pit latrines that are in poor physical and unhygienic conditions (Thomas et al., 2013). For example, in the vicinity of UMNP where pit latrine and manual drilling well have been widely used, due to the high water table and heavy precipitation during rain seasons in the country, it is very likely that human excreta stored and accumulated in latrines 15 feet below ground surface will occur in the water table, thus contaminate the groundwater.

1.1 ISSUES ON WATER

There are over 2.6 billion people in the world living a life without safe water supply (Thomas et al., 2013).

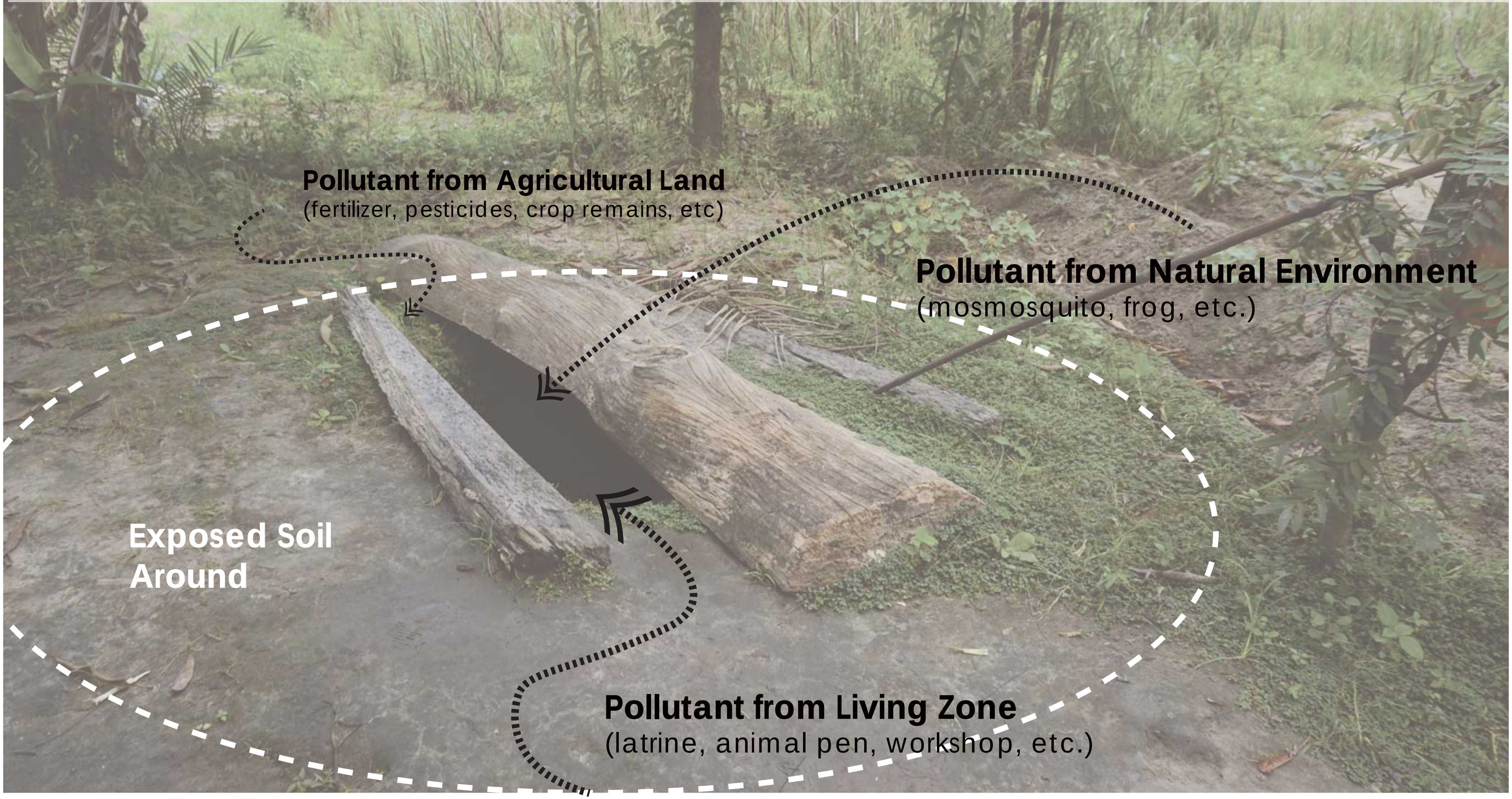
Many of the tanzanians in rural area use open well as their major water source for drinking, cooking, cloth washing and irrigation.

Drinking Water Condition From Village Well

Photo taken in Magombera on June 13th, 2016

1.1 ISSUES ON WATER

The exposed, manually drilled well used in many of the villages in the country is often opened to various sources of pollutant, including fertilizers and pesticides from **agricultural land**, chemical contaminant from **wastewater discharge**, and even bio-chemical pollutants from surrounded **natural environment**.



1.2 ISSUES ON SANITATION

It is estimated that 93 % of the Tanzanians have latrine in their home. However, only 24 % of these population has access to the improved sanitation infrastructure like sewage system and wastewater treatment plant. The o**ther 76% population**, especially people living in rural areas, still use the traditional pit latrine. (Thomas et al., 2013)

It is also suggested that in rural areas, lack of **solid waste collection** and **poor drainage** combined with **extensive use of pit latrines** together make for very poor hygiene conditions. (Thomas et al., 2013).

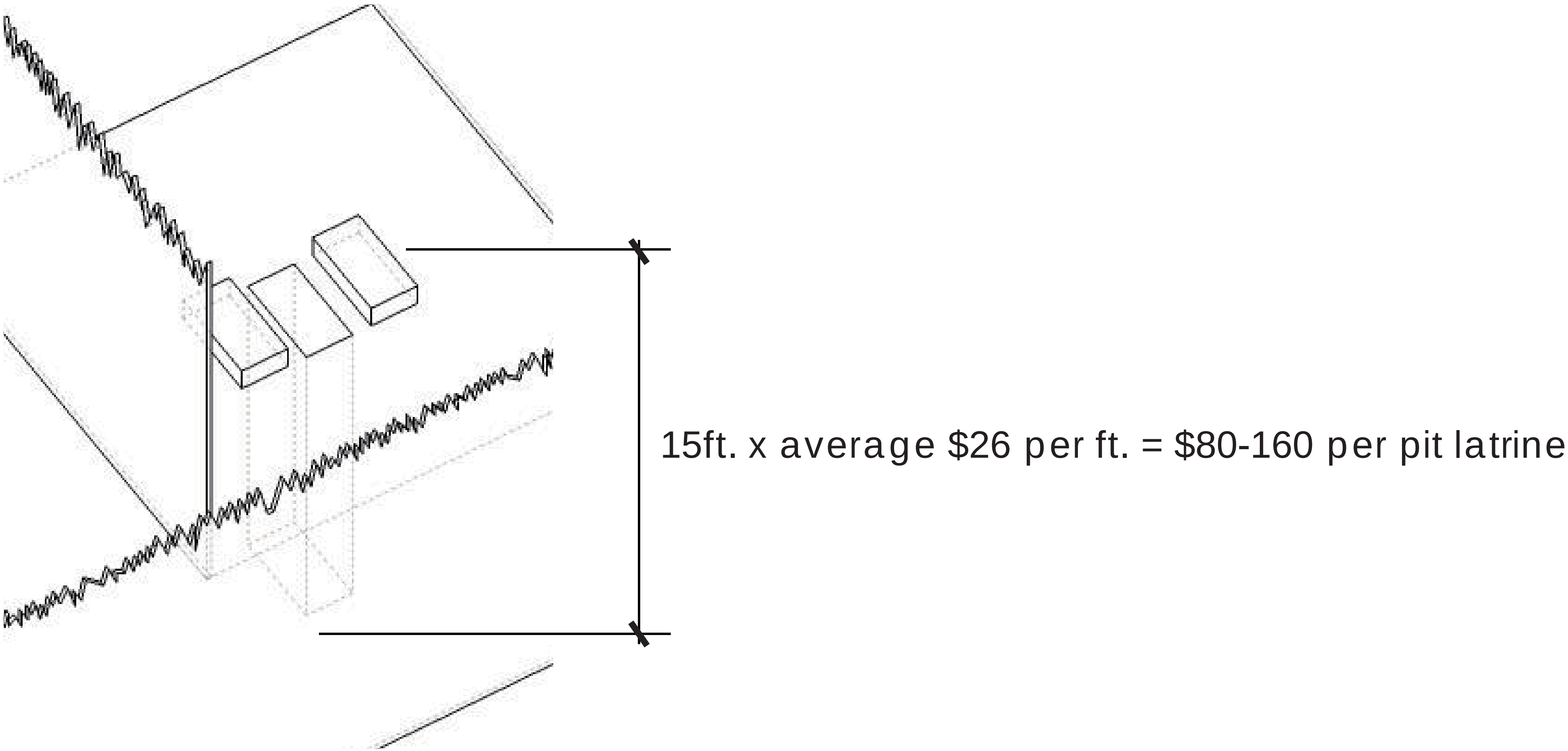
Left: Typical pit latrine with earth floor and privacy screen made from hessian and palm fronds. (p11)
Right: Flooded latrine in Dar es Salaam which is full due to the high water table. (p7)

Photos from A REVIEW OF SANITATION AND HYGIENE IN TANZANIA by Dr Jacqueline Thomas.

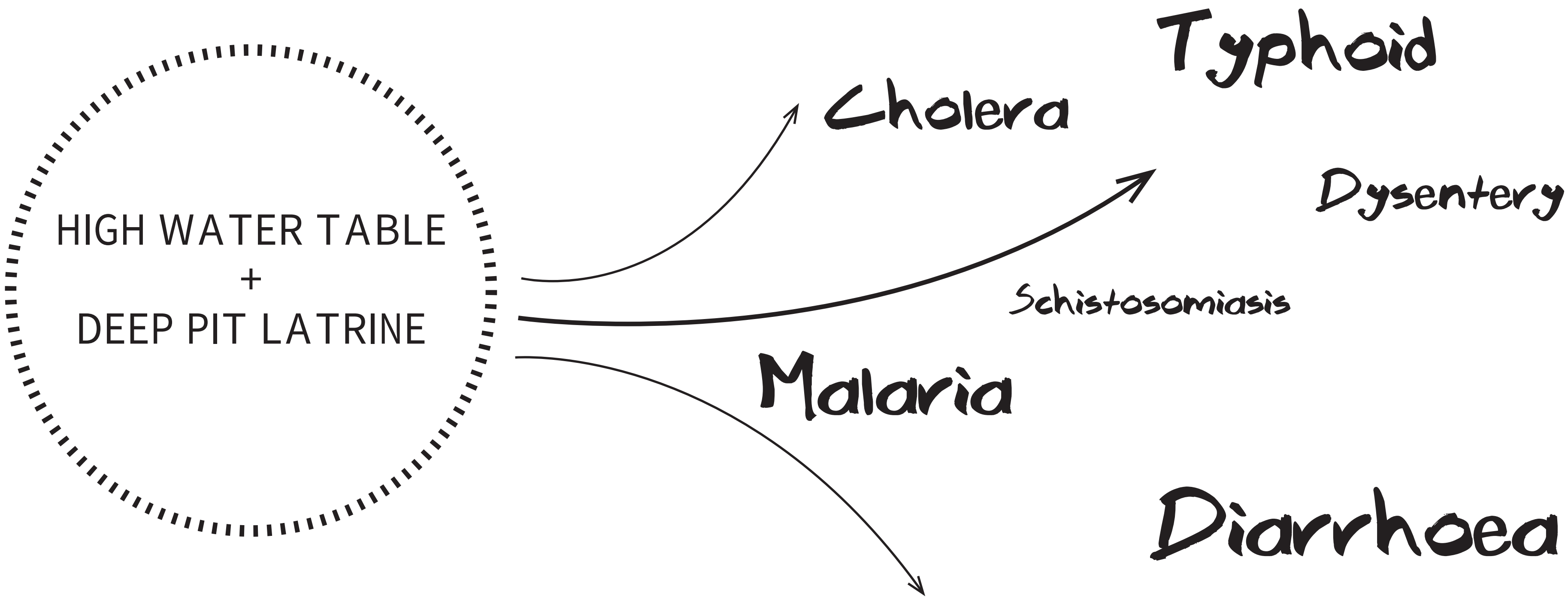
1.2 ISSUES ON SANITATION

Most of the basic latrines in use have a depth of **15 ft**, and cost between **80-160 USD**, with most of the cost going for pit digging which cost on average 26 USD per ft. It also need frequent repairs and even reconstruction after every **2-3 years.** (Jackson Wandera in *SNV/WEDC Sanitation Action Research*)

Apart from the lack of durability, other negative comments have also been mentioned by villagers, including “unsafe, difficult to clean, do not offer privacy, smelly, and infested with flies” (Jackson Wandera in *SNV/WEDC Sanitation Action Research*).



1.3 ISSUES ON HEALTH & DISEASES



With such high water table all year round and the use of unimproved pit latrines in most of the country's rural areas, the prevalence of water-related diseases (diarrhoea, typhoid, dysentery, etc.) seems inevitable.

For example, Dr. Thomas mentions in her article *A REVIEW OF SANITATION AND HYGIENE IN TANZANIA that* **"Diarrhoea** is reported on average in 15 % of children under five years of age and results in 9 % of all mortality for this age group. **Cholera** and **Typhoid** is endemic in some areas of Tanzania and outbreaks are common. What's more, there is the ever present problems of water-related parasitic infections such as **malaria** and **schistosomiasis**. Prevalence of these infections in Tanzania has been scientifically linked to poor sanitation and hygiene; in particular a access to latrines, poor hand washing behaviour, and inadequate drainage." (p2)

2 LANDSCAPE FRAMEWORK

This project tries to solve the problems mentioned above with the introduction of a new, infrastructural landscape framework to rural villagers who are unable to get access to public sewage system or wastewater treatment. The framework attempts to solve the conflict between feces disposal and clean water acquisition. By rearranging the existing land use pattern based on household activities, this design helps to separate natural water source from human and animal feces, as well as setting up a circulatory system that transfer the energy from fecal matters and other waste to various uses including cooking and fertilization.

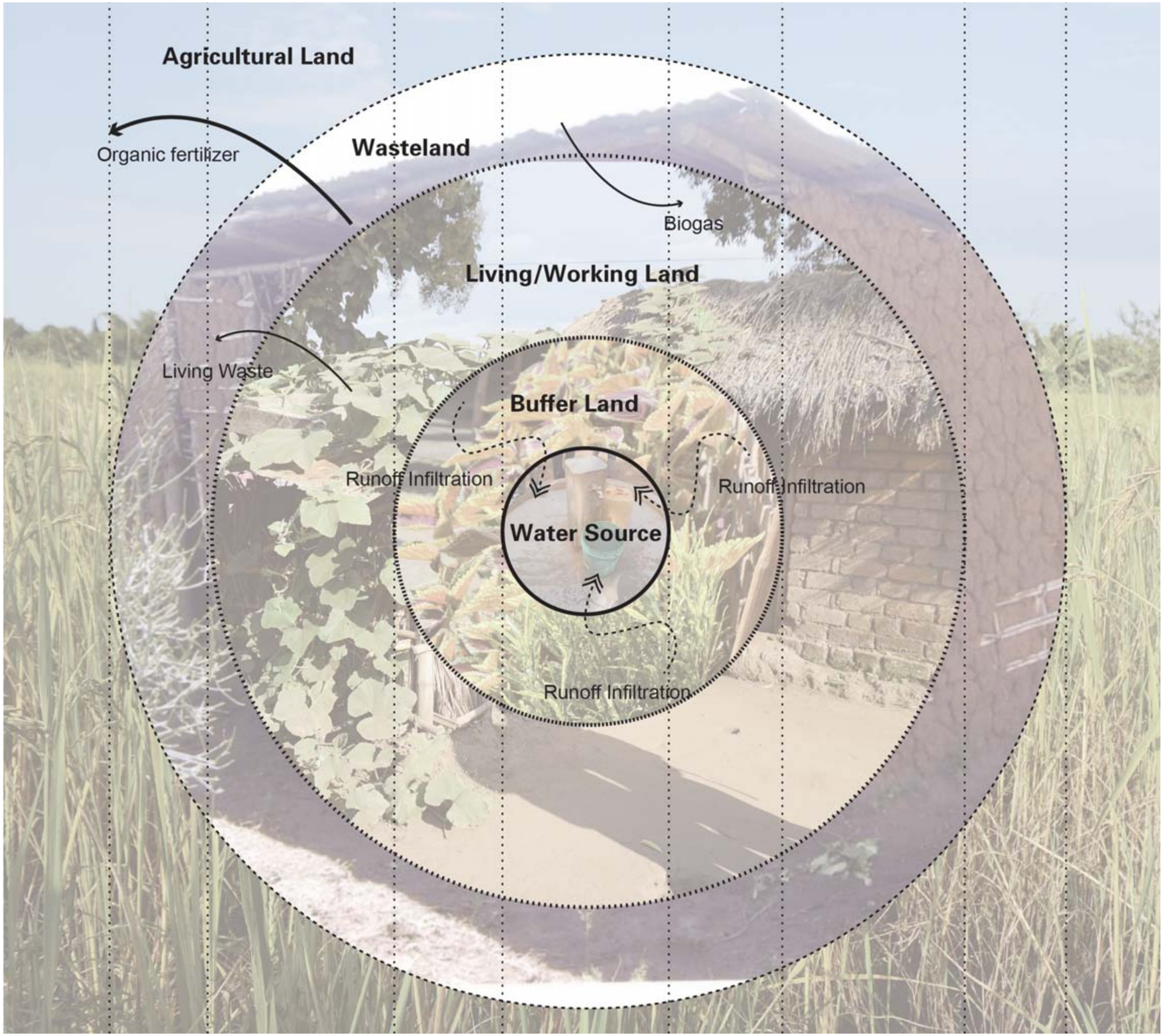
2.1 LAND USE SEPARATION

Landscape as infra-structural framework:

Separation of
Water Source
(well, water pump, reervior, etc.)

and

Wasteland
(latrine, bathroom, animal pen, etc.)



2.2 WASTE COMPOSTING SYSTEM

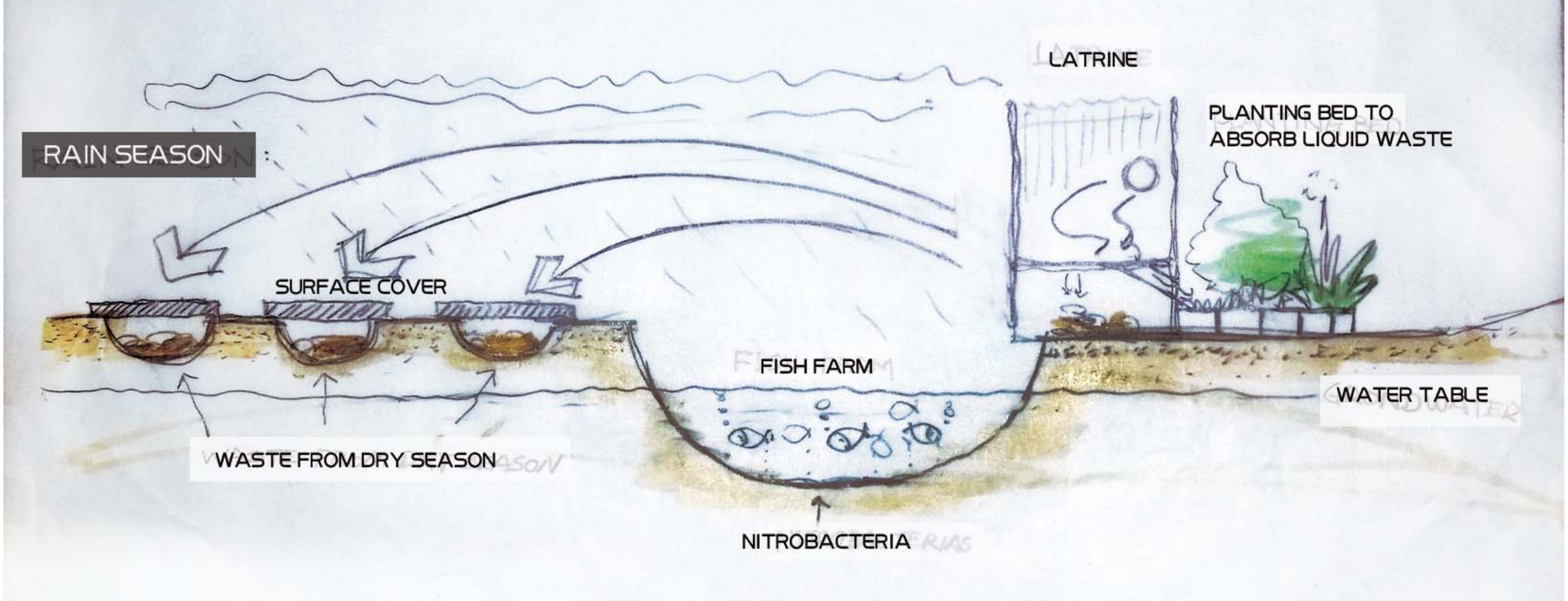
The wasteland mainly consists of three components: latrine, concentrated compost tank and scattered compost tank.

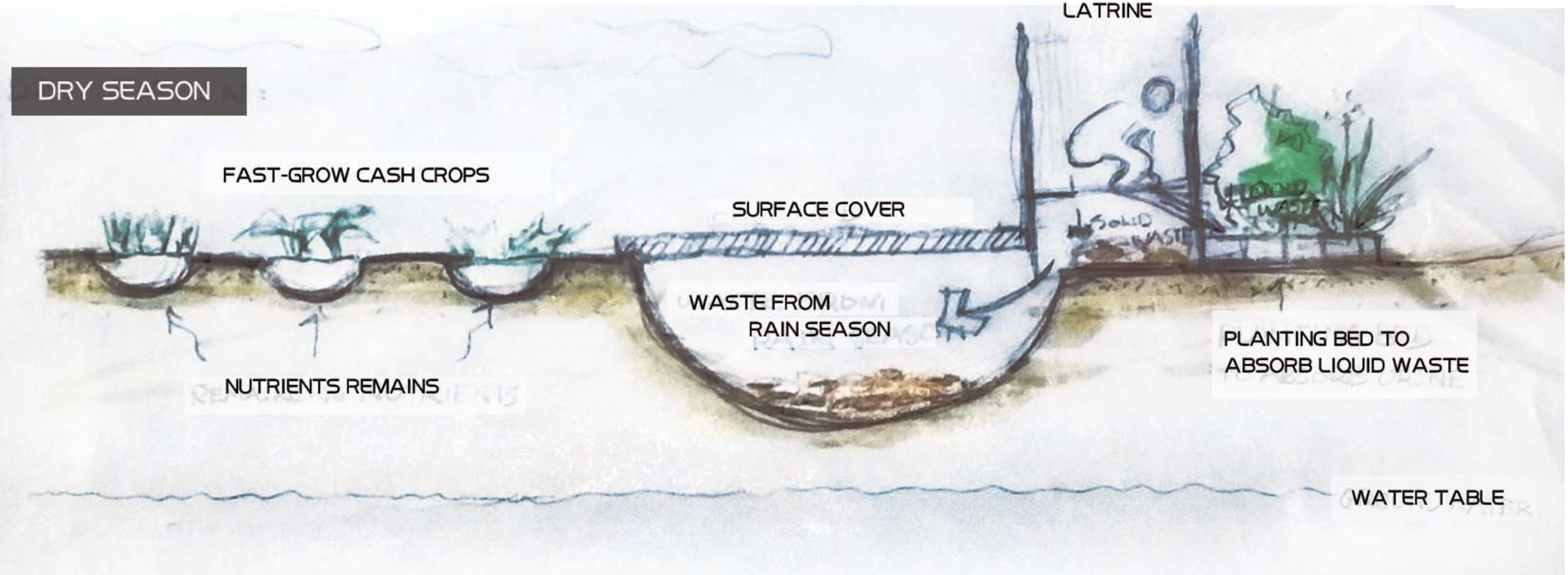
In latrine, the urine that contains no bacteria will be divided from the solid waste and stored under the bathroom, which later be mixed with wastewater from bathroom and discharged into a planting bed adjacent to the toileting area, where salt-resistant plants are planted to absorb the nutrients directly from the waste water . Solid waste are temporarily stored in separate chambers besides latrine. Composting cover materials like wood ash from kitchen should be applied after each use of the latrine to get rid of the nasty smell, keeping flies away from fresh organic materials, and hasten the breakdown of diseases by accelerating the start of the composting process (BETNAR, 2013).

After stored in the compost chamber for some time, the waste is to be transferred into compost pools outside latrine, which effectively reduce the concentration of fecal pathogens in composted human/animal manure, while producing a nutrient-rich fertilizer. Instead of digging a huge, deep hole for the storage of excretal waste every two years (like the traditional latrine which may probably occur to the water table after heavy precipitation), it is suggested to dig several permanent compost pools according to the seasonal water table change. The pools for the rain season storage should be shallower and smaller, keeping a distance from the groundwater and getting filled and renewal more frequently due to the hot, wet climate; while the pools for dry season can be deeper and larger for management convenience.

The complete decomposing process generally takes 3-4 months, which means that it will definitely be a waste of land if the pools only be used as compost space. Two productive activities have been suggested here to make the full use of land. During rainy season, all the shallow pools are filled up with decomposing waste from last three months, while the deeper pool which bottom is under the water table can be used as temporary fish farm. After the harvest of fish at the end of rainy season, the bottom soil of the pool is full of fish waste that generates perfect environment for the growth of natural decomposers like nitrobacteria. As the dry season comes and the water table drops down, the former fish farm site with sufficient decomposers is ready to take the waste for decomposition. As for the wastes in previous compost pools, after a full season of decomposing, they have already been transferred into good organic fertilizers that can be immediately applied to the field outside the sanitary circle, and the empty pools with nutrients remains can be used as temporary fields for some quick-growth cash crops like onion, garlic or ginger.

Methane tank can also be added to this circle if economic status allows, which generates gas for cooking and helps to reduce the use of fuelwood.


RAIN SEASON
LATRINE
PLANTING BED TO
ABSORB LIQUID WASTE
SURFACE COVER
FISH FARM
WATER TABLE
WASTE FROM DRY SEASON
NITROBACTERIA

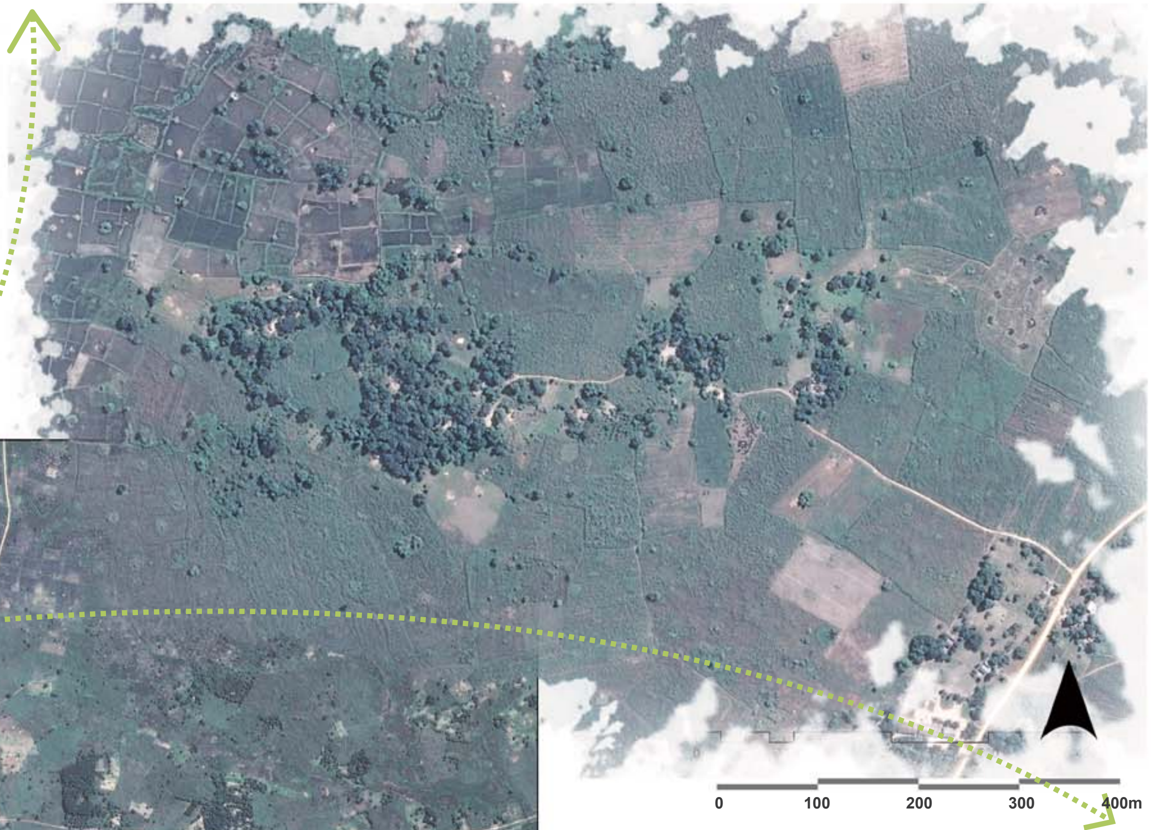

DRY SEASON
LATRINE
FAST-GROW CASH CROPS
SURFACE COVER
WASTE FROM
RAIN SEASON
PLANTING BED TO
ABSORB LIQUID WASTE
NUTRIENTS REMAINS
WATER TABLE

3 SAMPLE SITE ANALYSIS

A small part of Magombera Village in the vicinity of UMNP, with about 40 households, has been chosen as the sample site to apply the landscape framework proposed in previous chapter. Being one of the poorest villages nearby, as well as settling isolated from the main body of Magombera, this part of village is less likely to be implemented with public sewage system or other sanitary facilities in near future, thus having great demand to develop their own compost system guided by the framework.

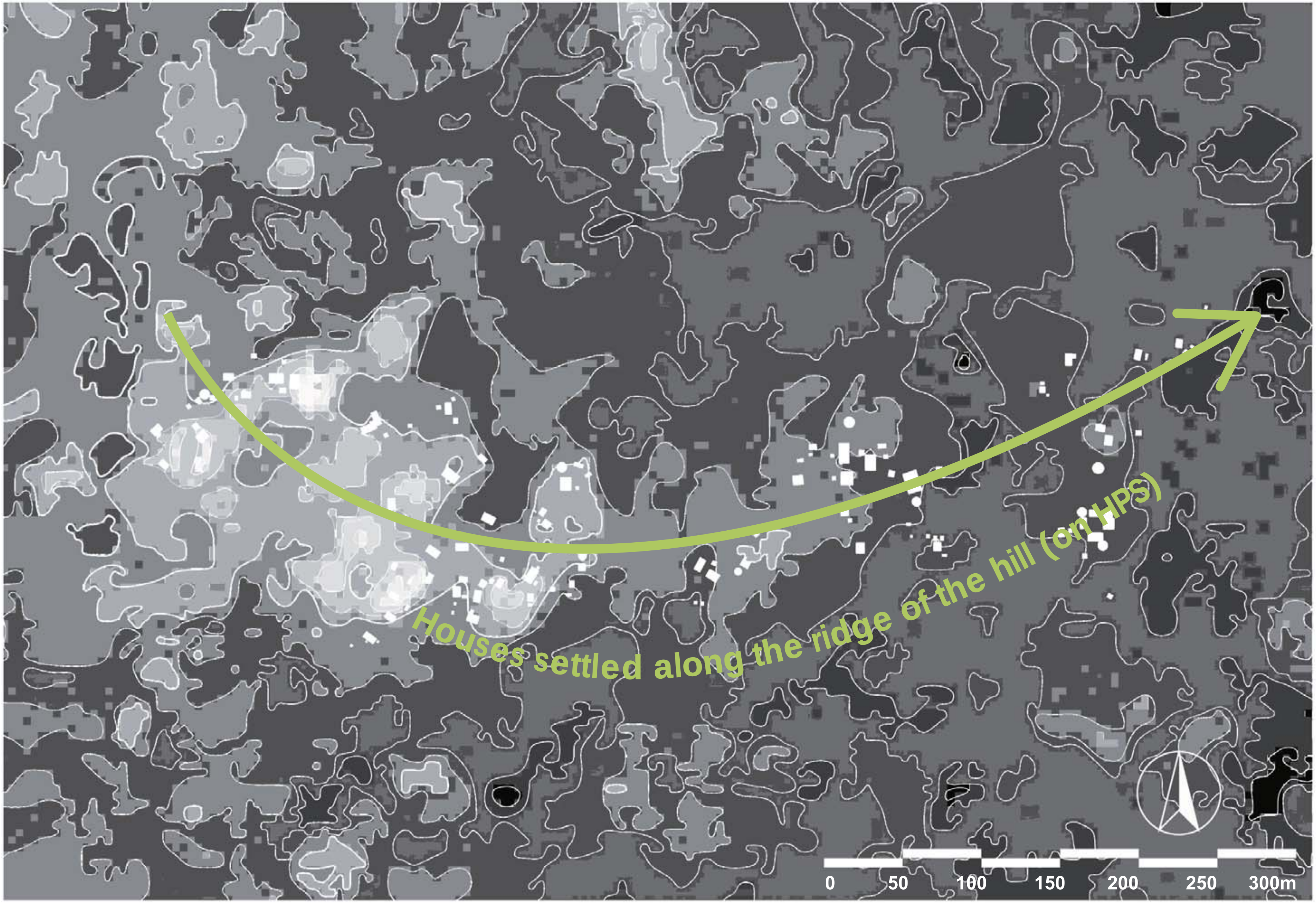
3.1 SITE LOCATION

A small part of Magombera Village in the vicinity of UMNP, with about 40 households, has been chosen as the sample site to apply the landscape framework.



Being one of the poorest villages nearby, as well as settling isolated from the main body of Magombera, this part of village is less likely to be implemented with public sewage system or other sanitary facilities in near future, thus having great demand to develop their own compost system.

3.2 TOPOGRAPHY

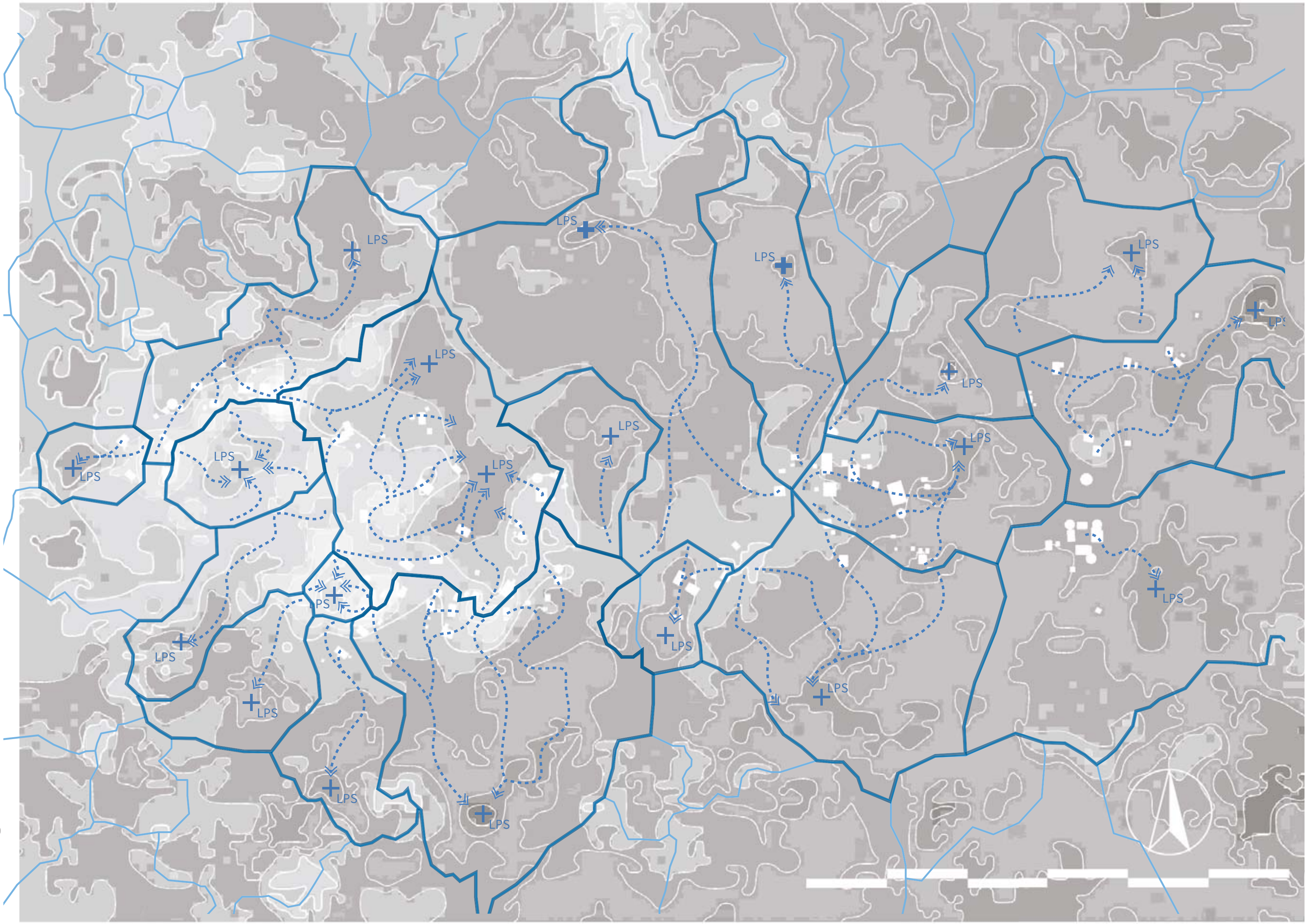


LEGEND (m)

281
282
283
284
285
286
287
288
289
290

3.3 HYDROLOGY

The site can be divided into several water catchments according to the slighly topography changes on site.



LEGEND

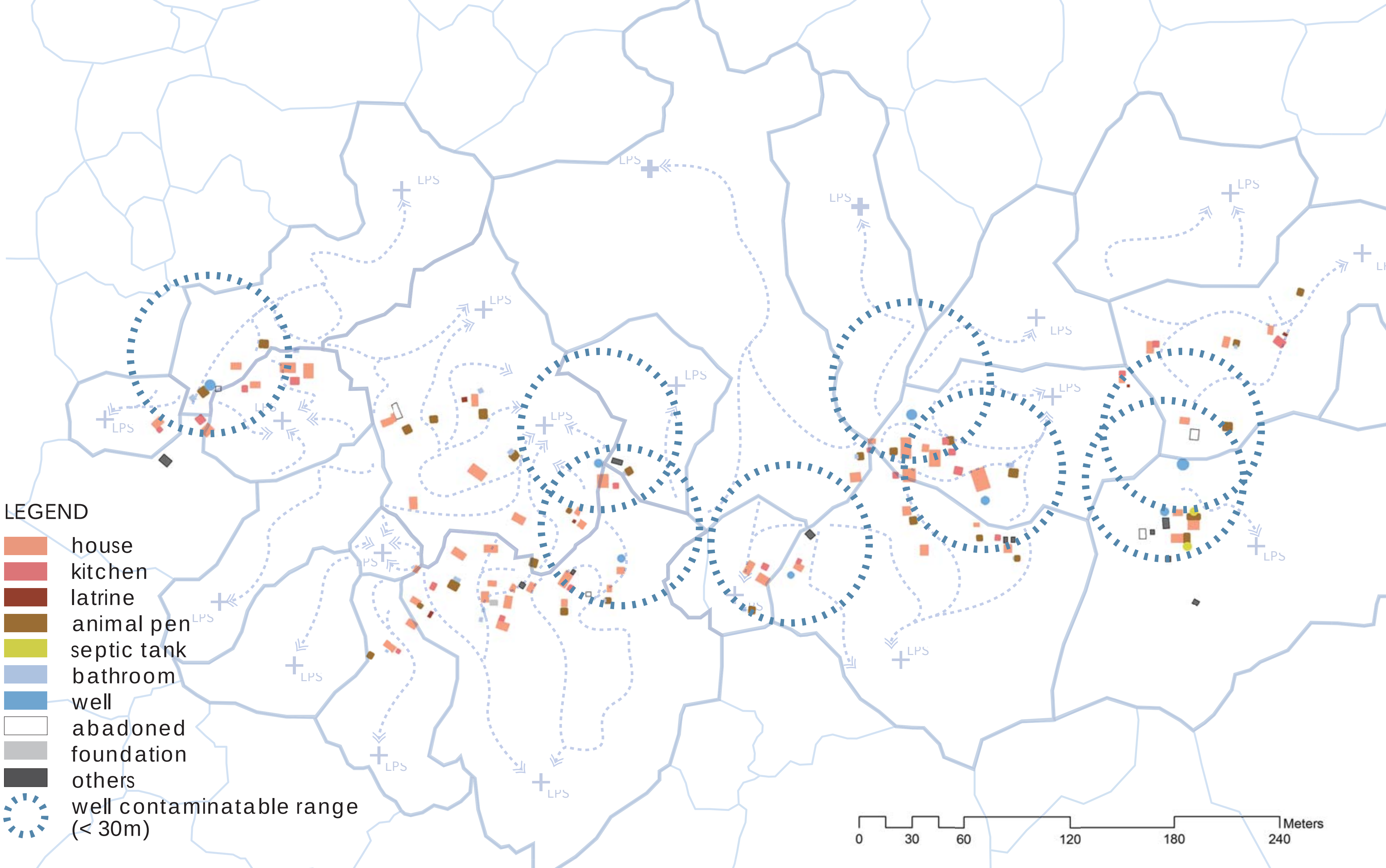
catchment (with structure)

catchment (without structure)

surfacewater flow direction

low point spot

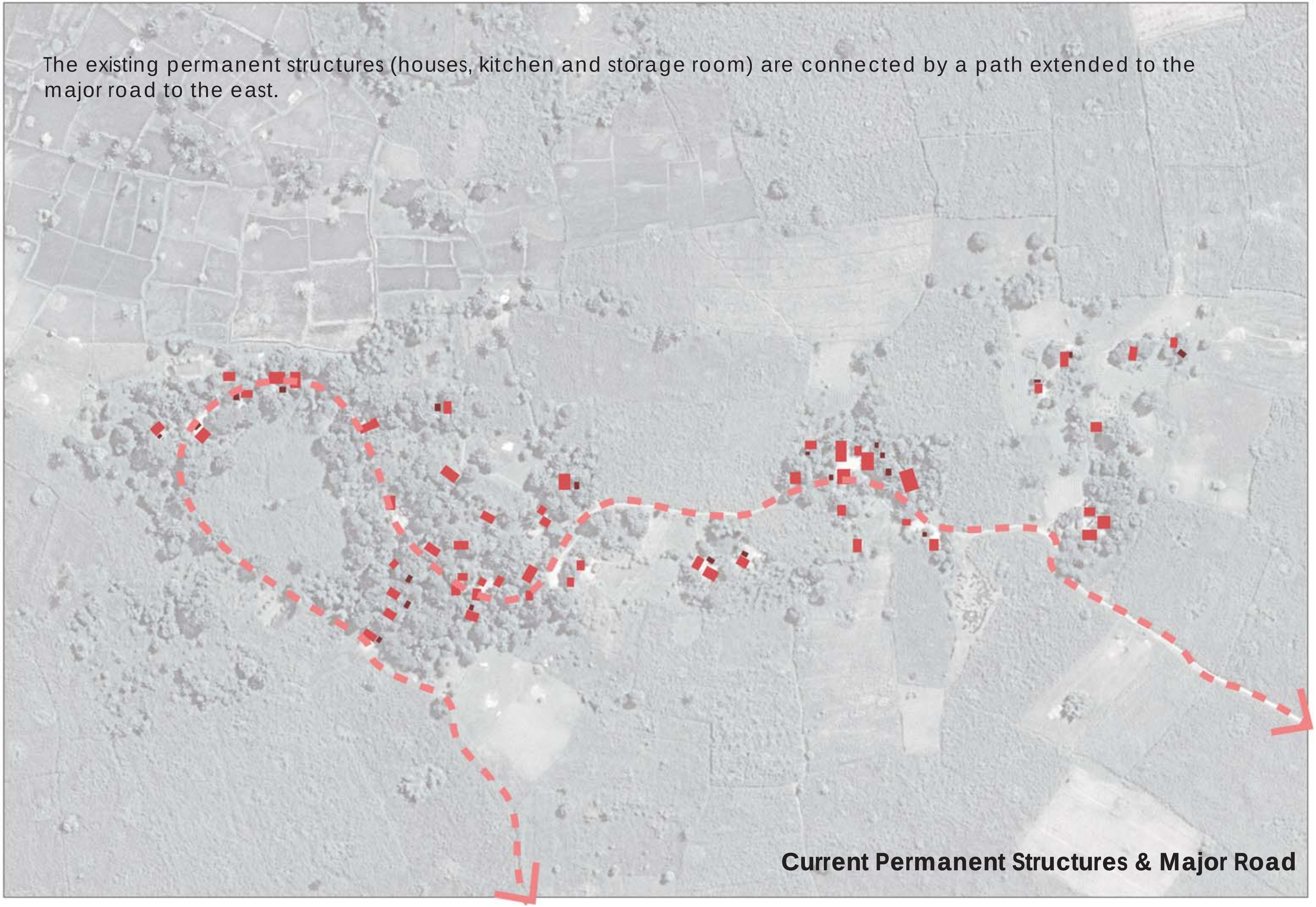
3.4 House Distribution



The contamination-sensitive zone, which is the space less than 30m from water source, should be kept pollutant-free for the safety of water. However, according to the GIS map of the village, there are many pollutant sources within this 30-meter buffer.

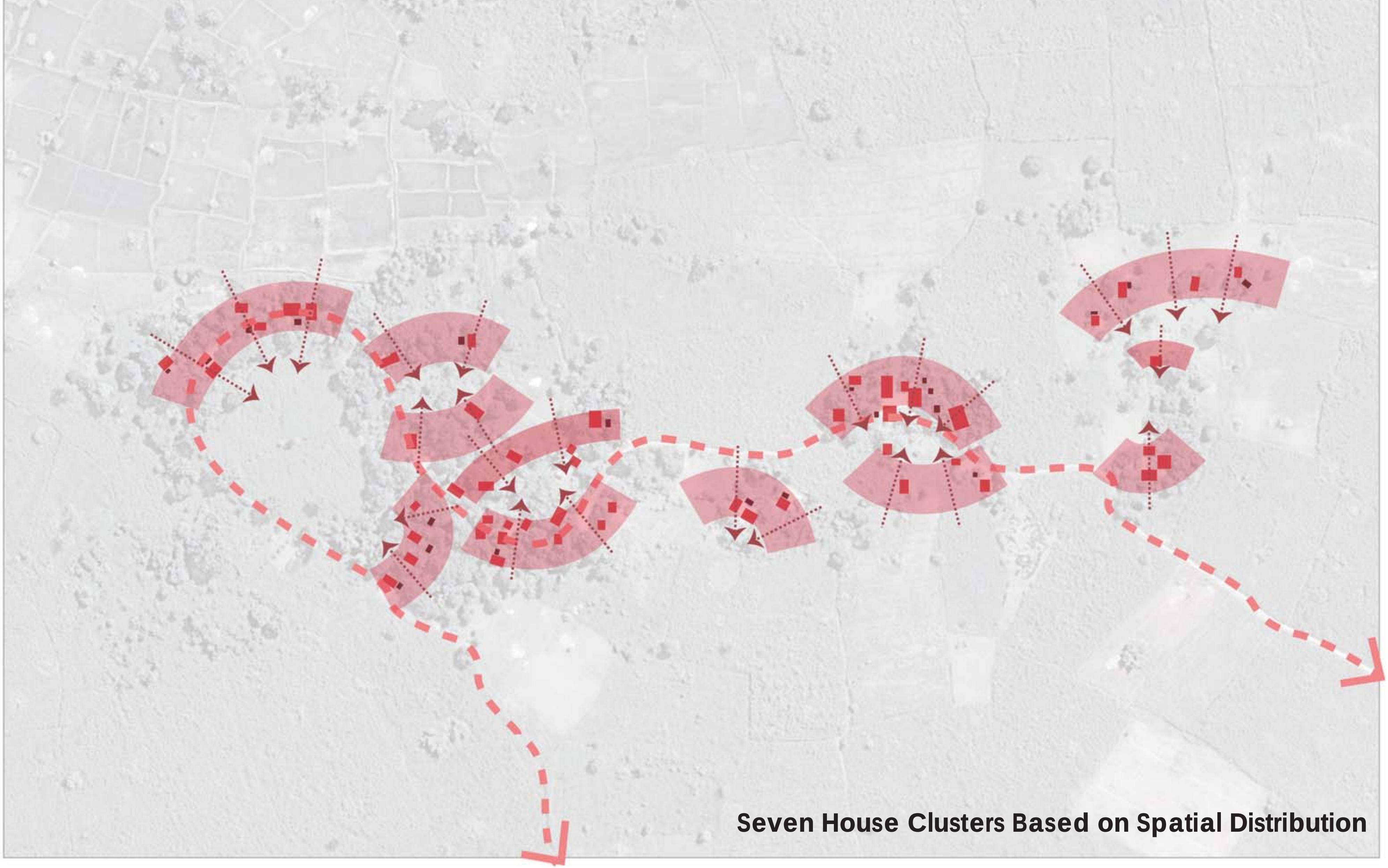
4 PROPOSED PROJECT
---- VILLAGE SCALE

4.1 HOUSE CLUSTER FORMATION



4.1 HOUSE CLUSTER FORMATION

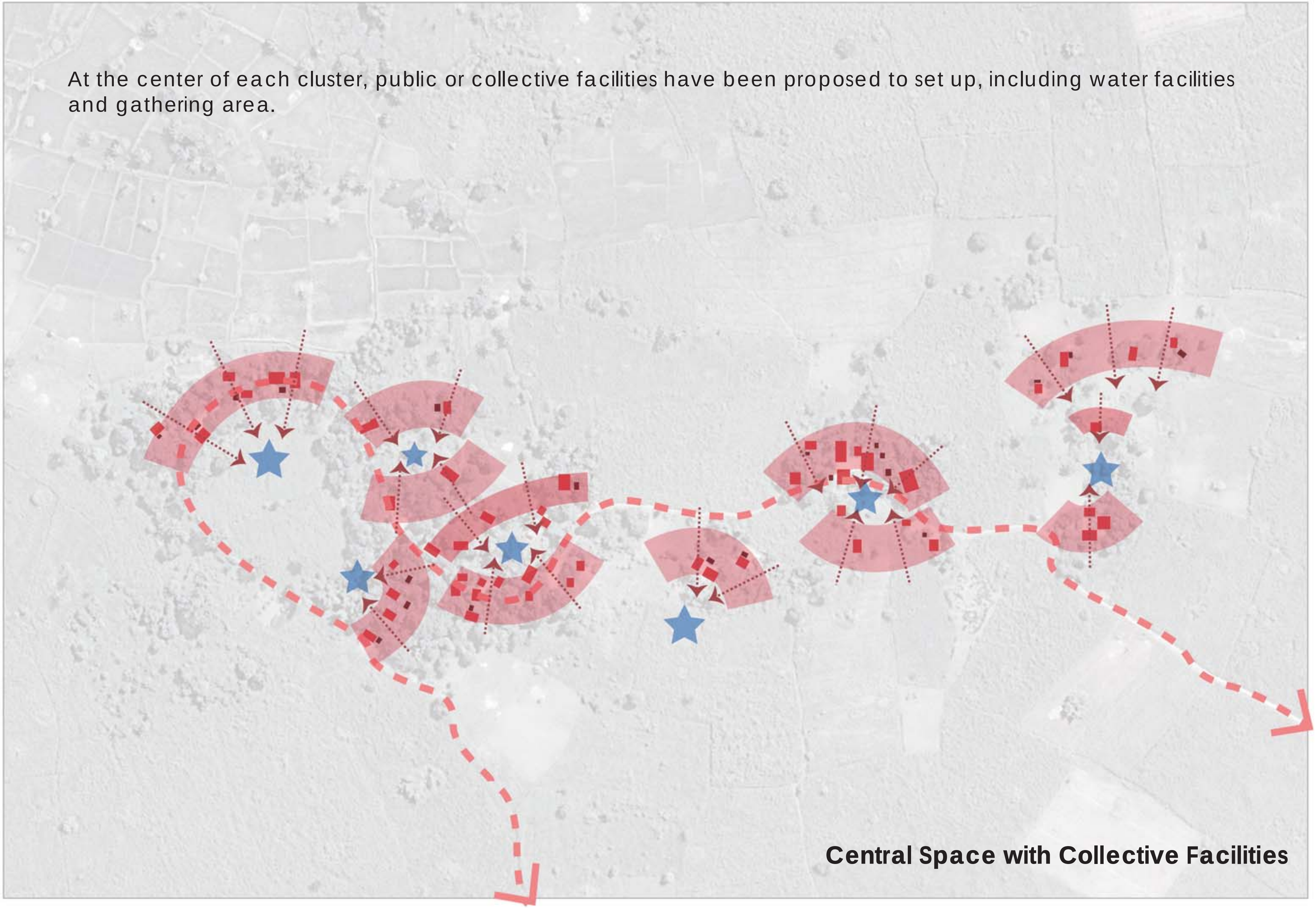
The houses have been grouped into seven clusters based on spatial distribution.



Seven House Clusters Based on Spatial Distribution

4.2 WATER & GATHERING AREA

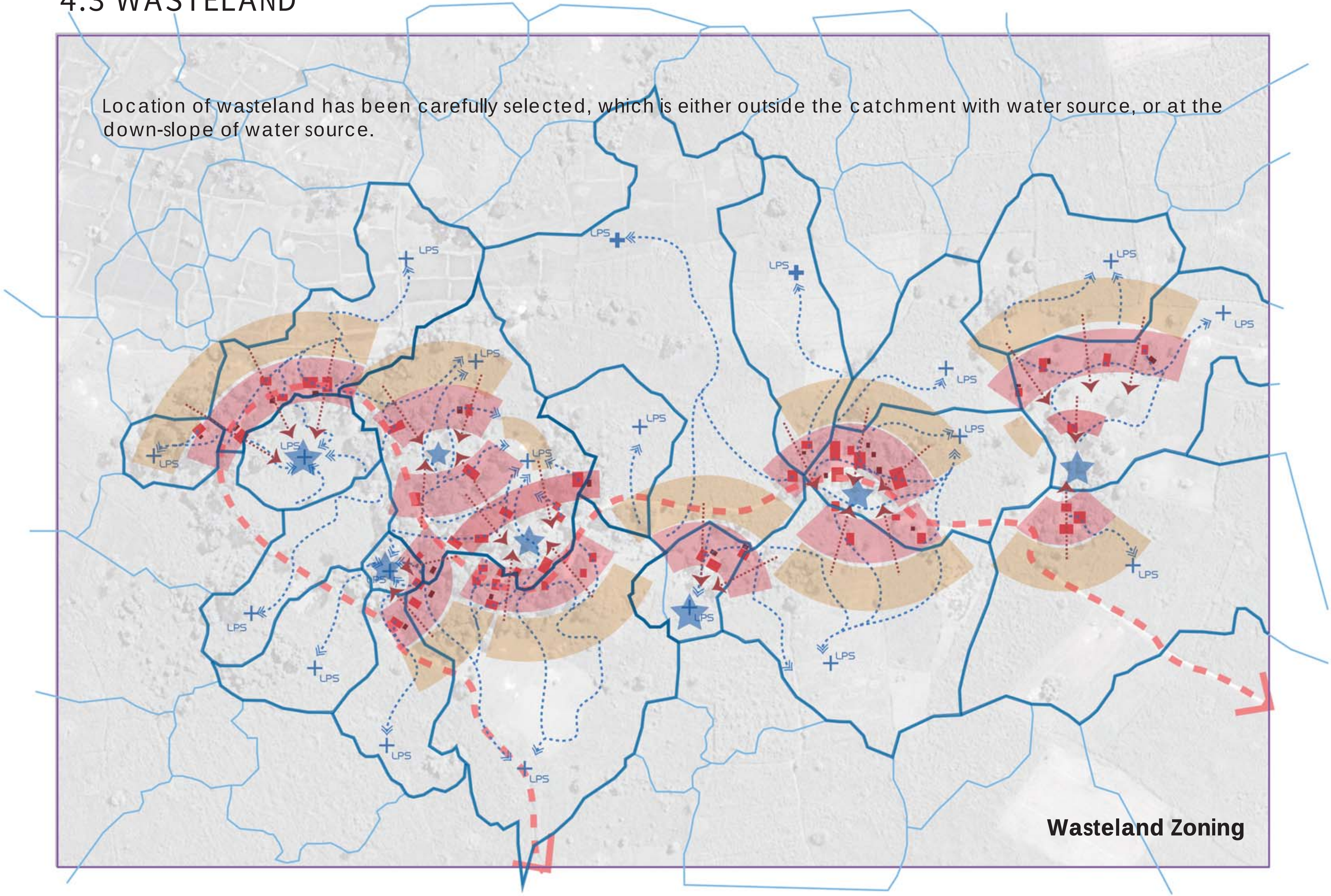
At the center of each cluster, public or collective facilities have been proposed to set up, including water facilities and gathering area.



Central Space with Collective Facilities

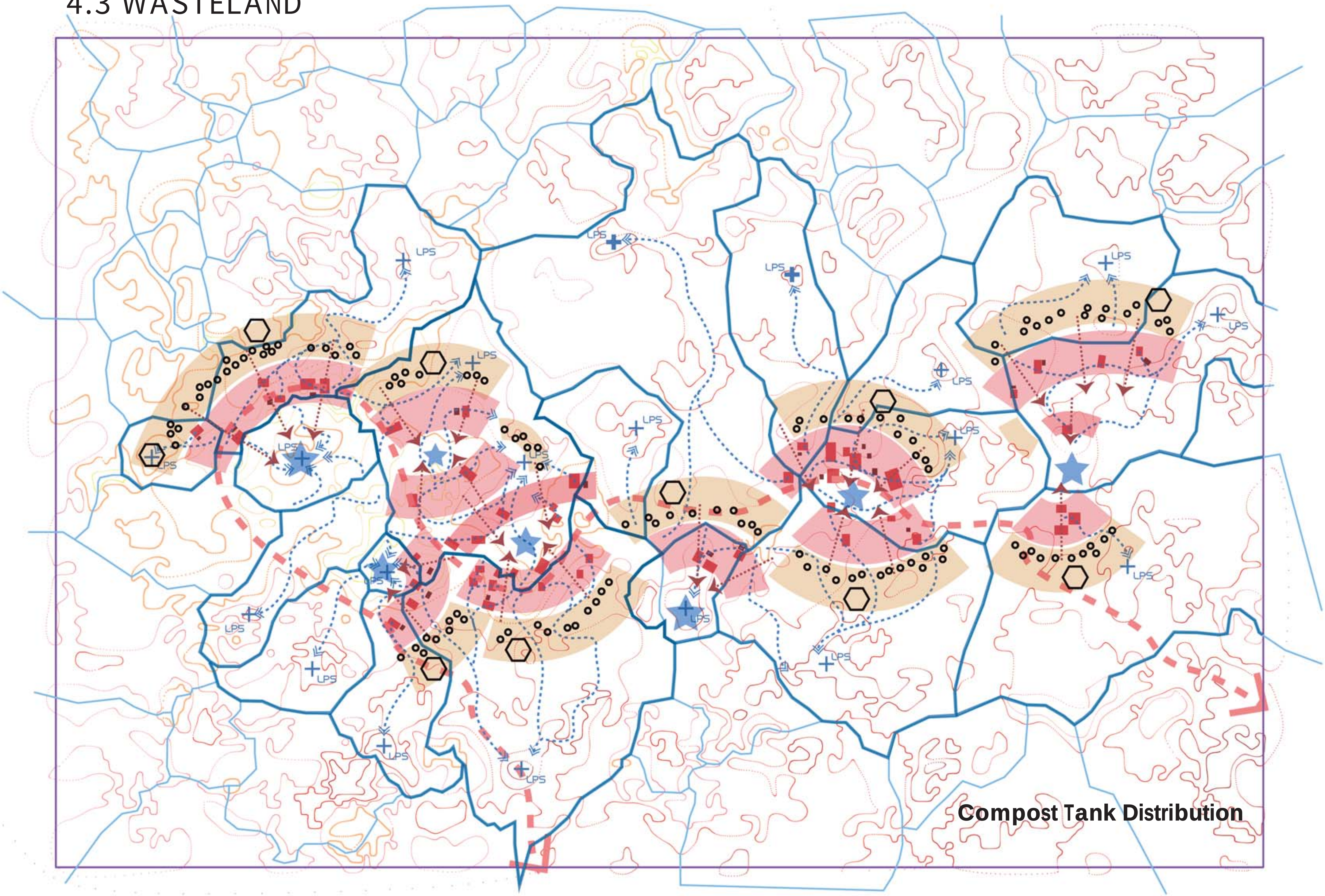
4.3 WASTELAND

Location of wasteland has been carefully selected, which is either outside the catchment with water source, or at the down-slope of water source.

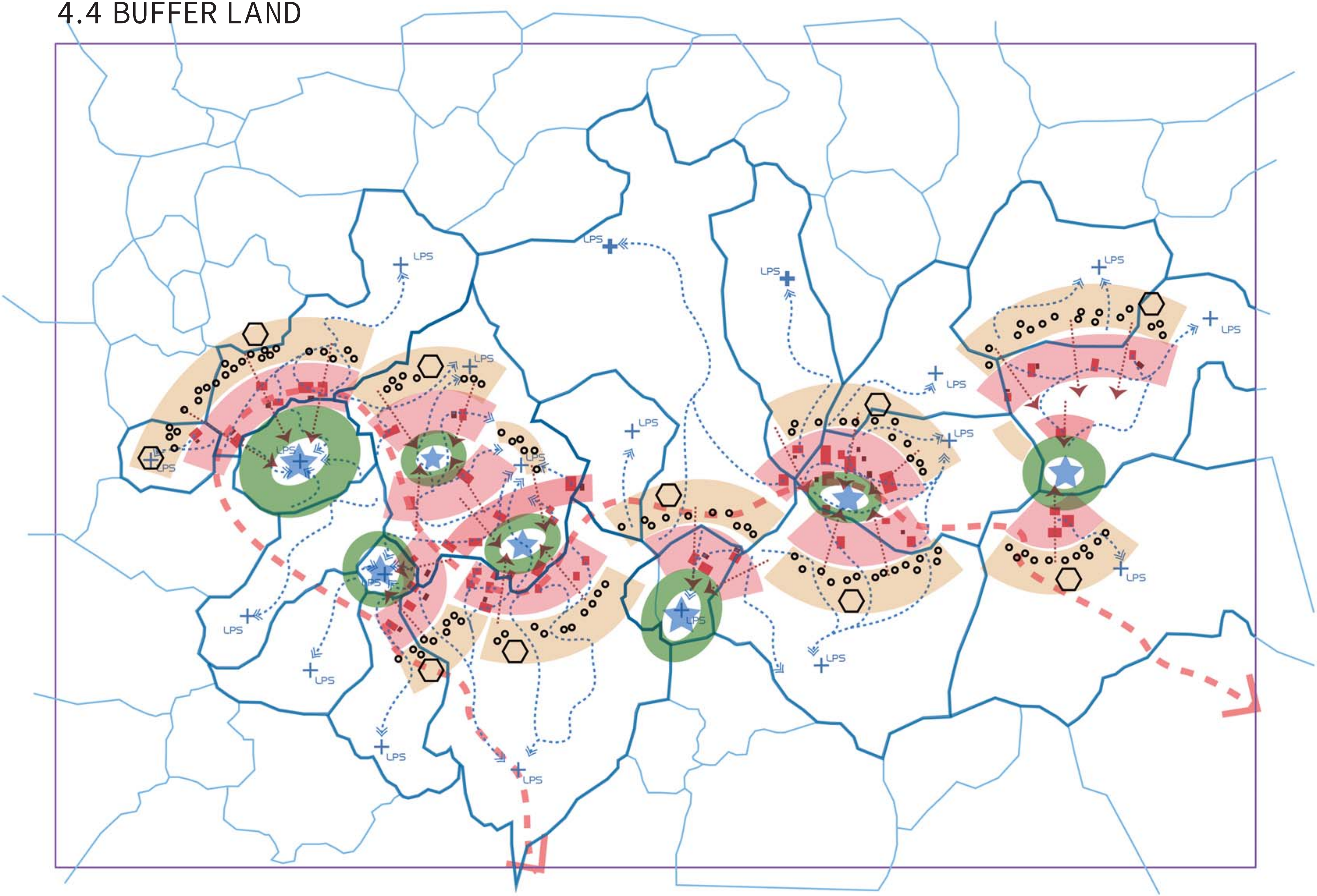


Wasteland Zoning

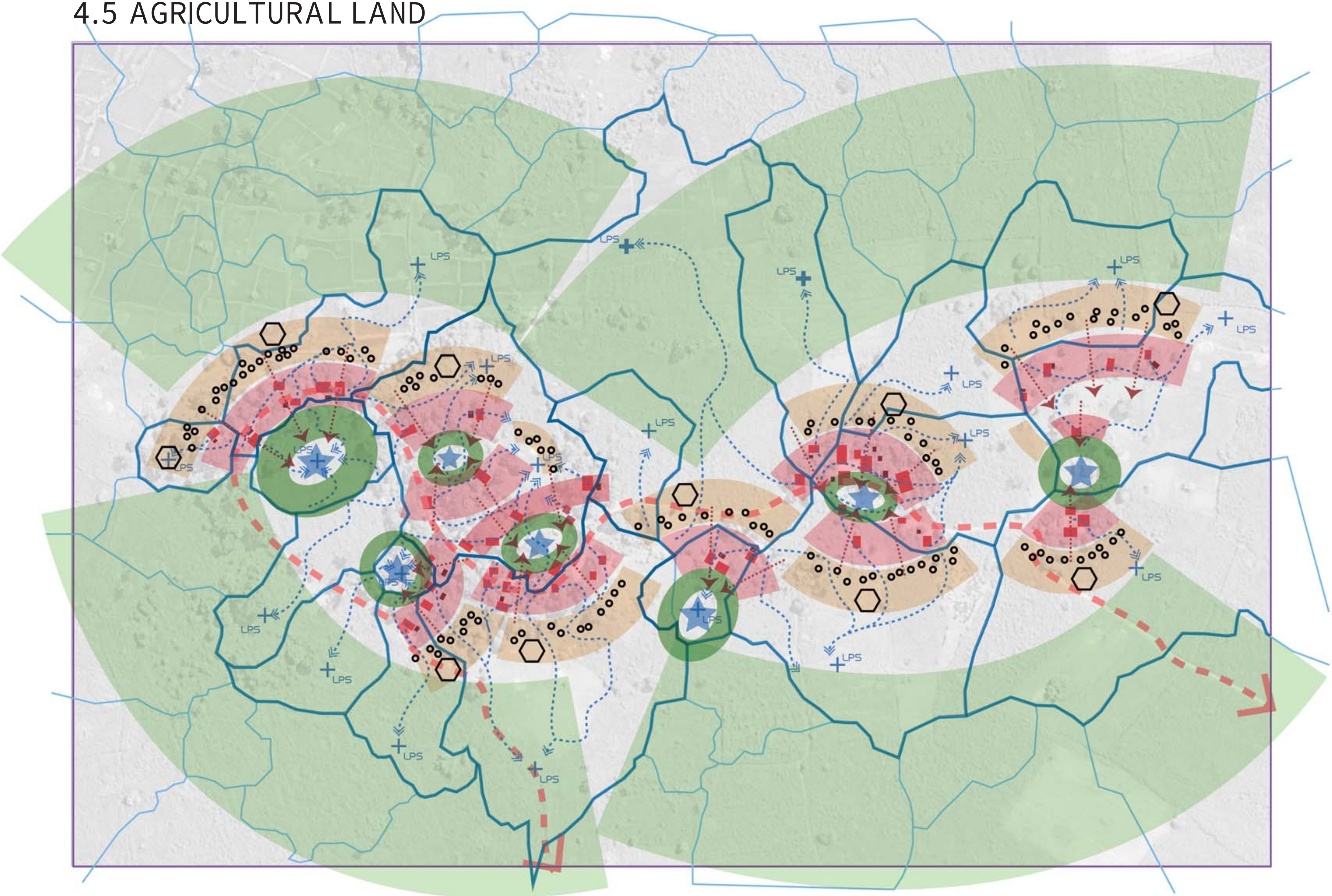
4.3 WASTELAND



4.4 BUFFER LAND



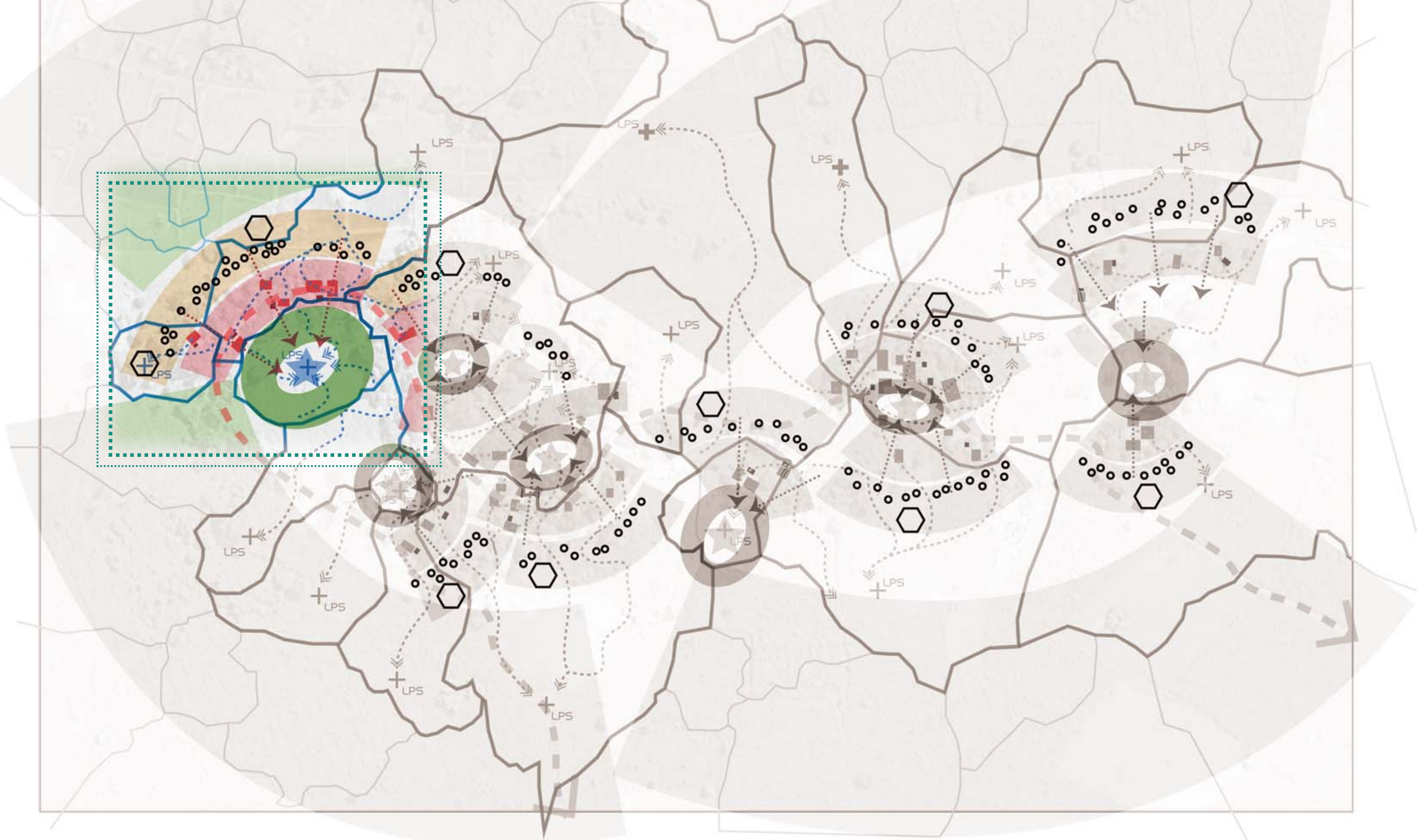
4.5 AGRICULTURAL LAND



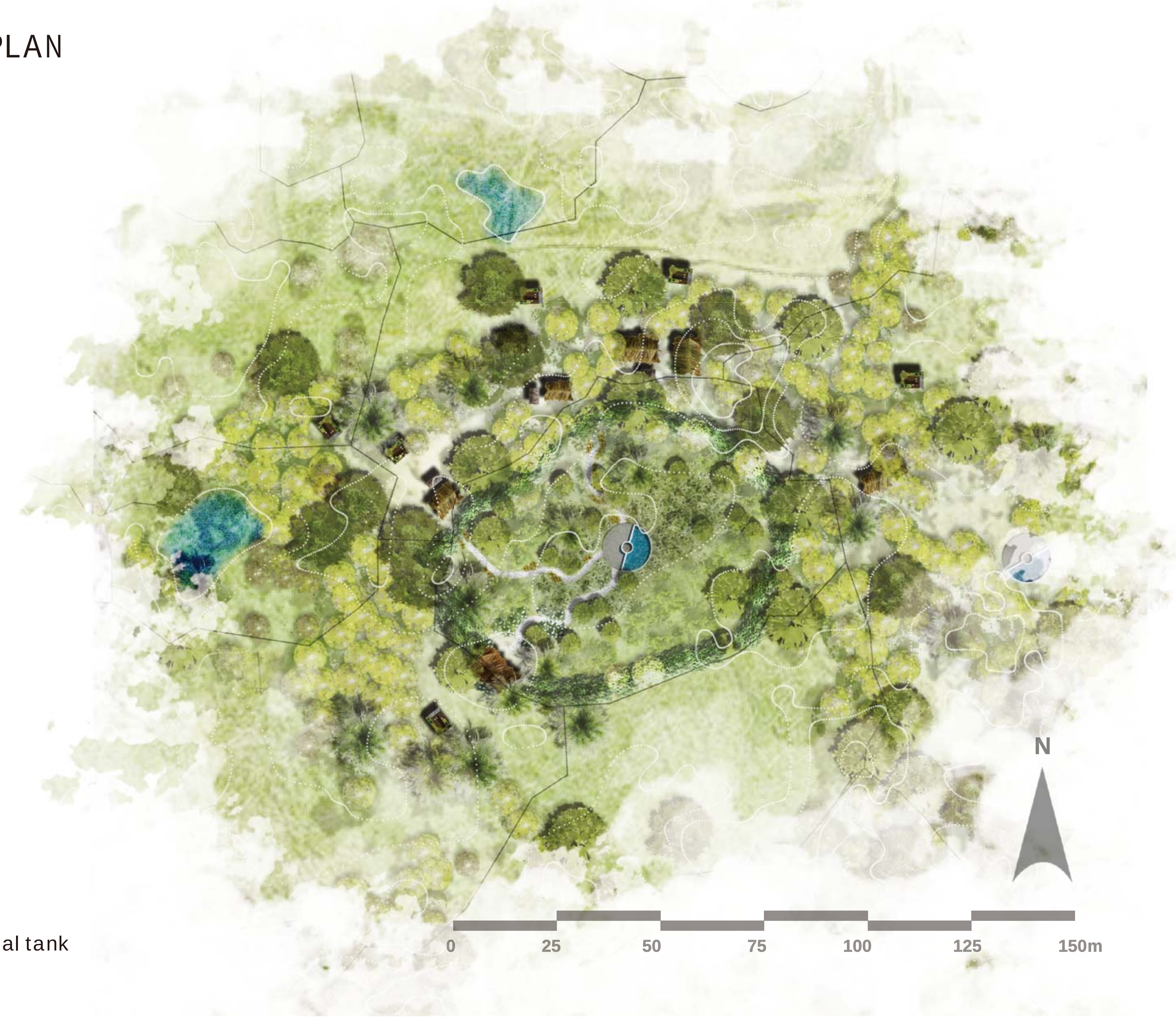
5 PROPOSED PROJECT
---- SITE SCALE

5.1 MASTER PLAN

One of the clusters has been chosen for site design to illustrate more details on how the new landscape framework accomplish its mission of providing better living condition to the villagers.



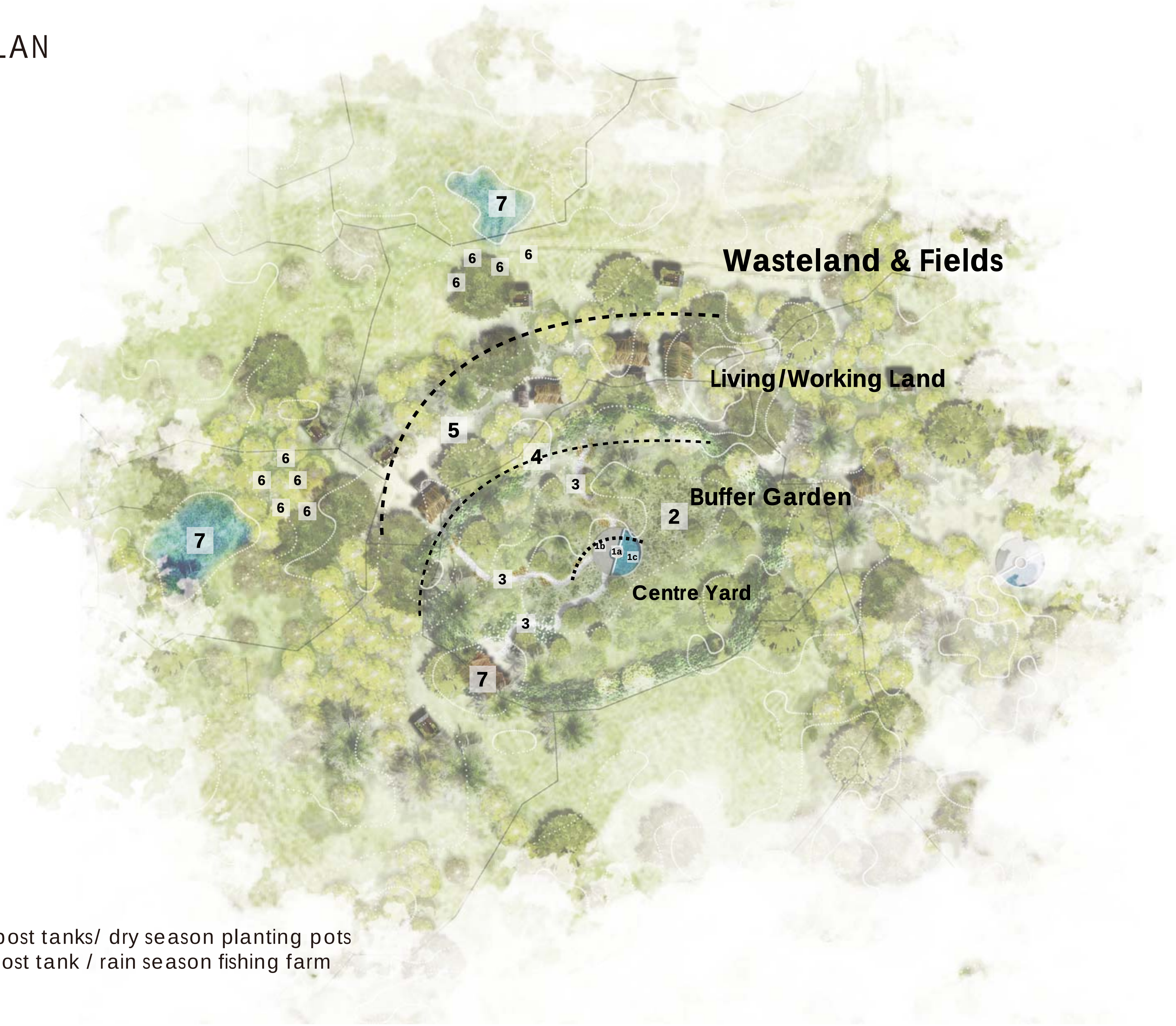
5.1 MASTER PLAN



LEGEND

- house
- latrine
- kitchen
- church
- buffer bush
- existing trees
- planted trees
- multi-functional tank

5.1 MASTER PLAN



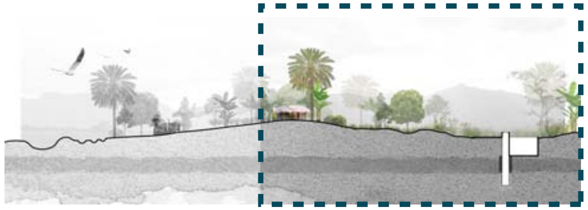
LEGEND

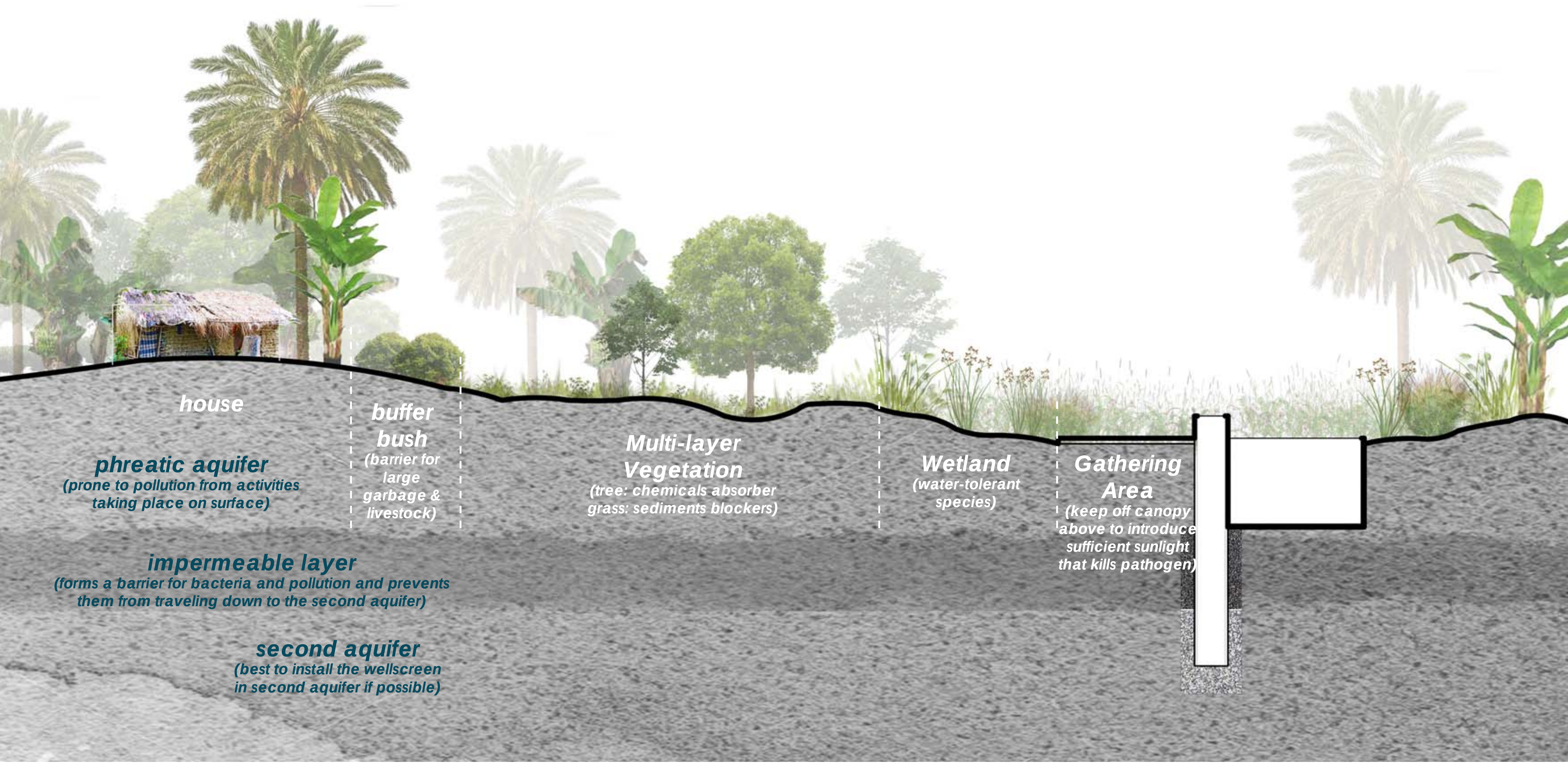
- 1a well
- 1b gathering area
- 1c reservior
- 2 wetland zone
- 3 gravel path
- 4 buffer bush
- 5 living zone
- 6 rain season compost tanks/ dry season planting pots
- 7 dry season compost tank / rain season fishing farm

5.2 SECTION


surface runoff
surface runoff
ground water concern:
latrine at least 30m away from water source
surface water concern:
do not place latrine at the up-hill of water source

5.3 BUFFER GARDEN

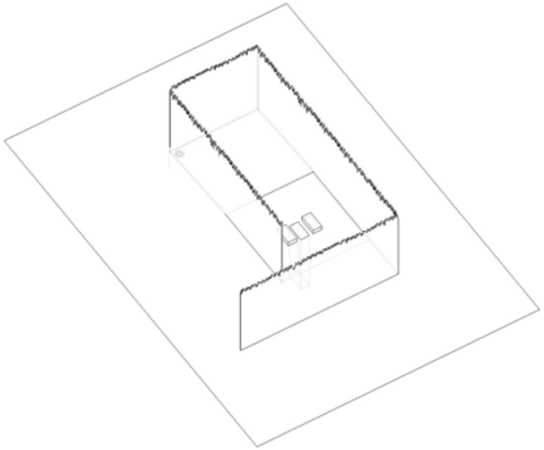




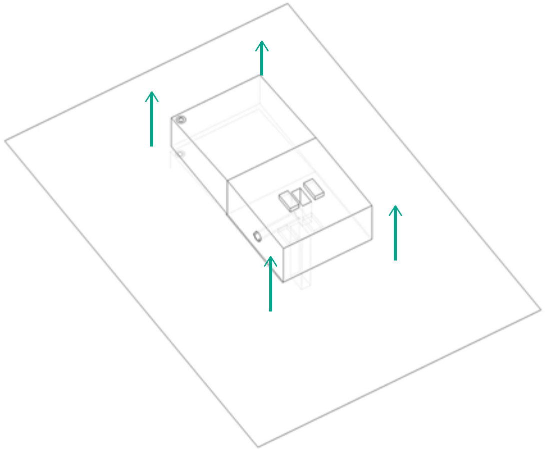
5.3 BUFFER GARDEN

5.4 LATRINE MODULE

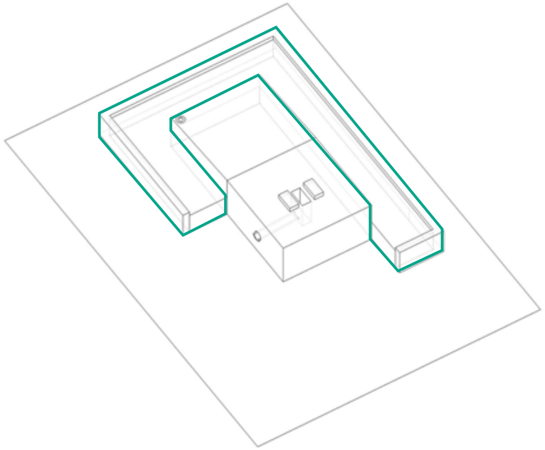
An improved latrine module has also been proposed here to better facilitate the storage and compost process established within the wasteland. The **raised base** above ground helps to keep waste away from high water table, while the **planting bed** and **surrounding screen** made from hessian and palm fronds provides privacy and aesthetic value to the latrine.



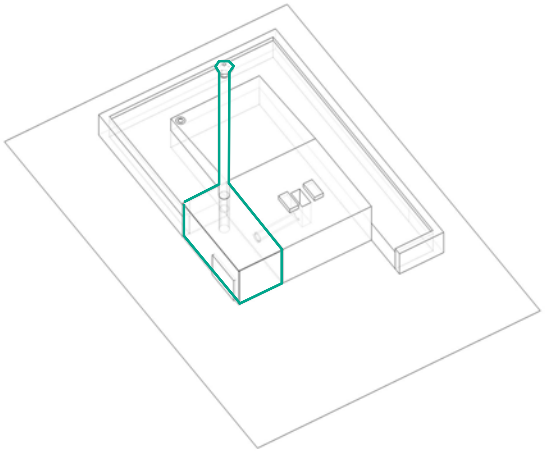
Traditional Pit Latrine



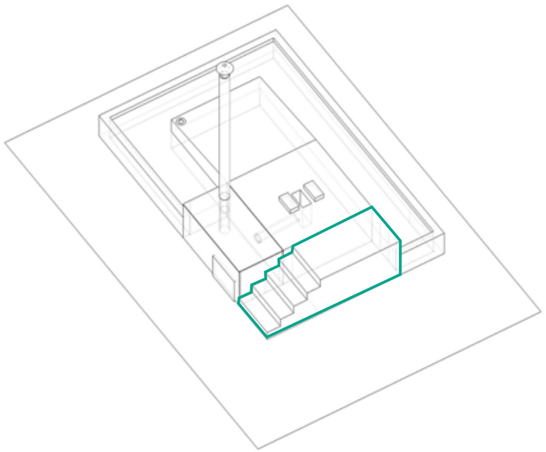
Raised Base



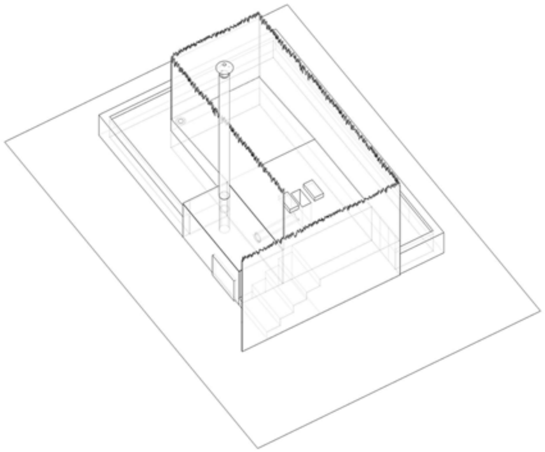
Planting Bed



Waste Storage Chamber

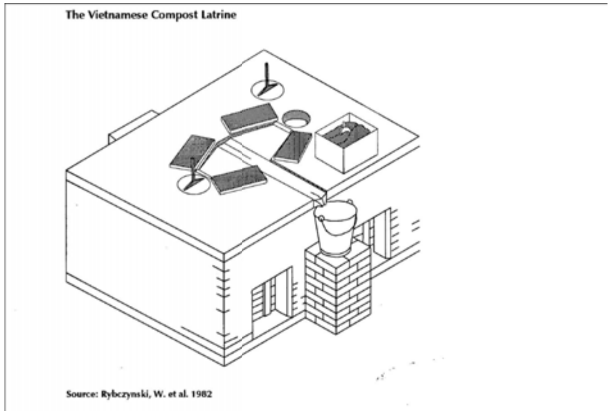


Stairs



Privacy Screen

5.4 LATRINE MODULE

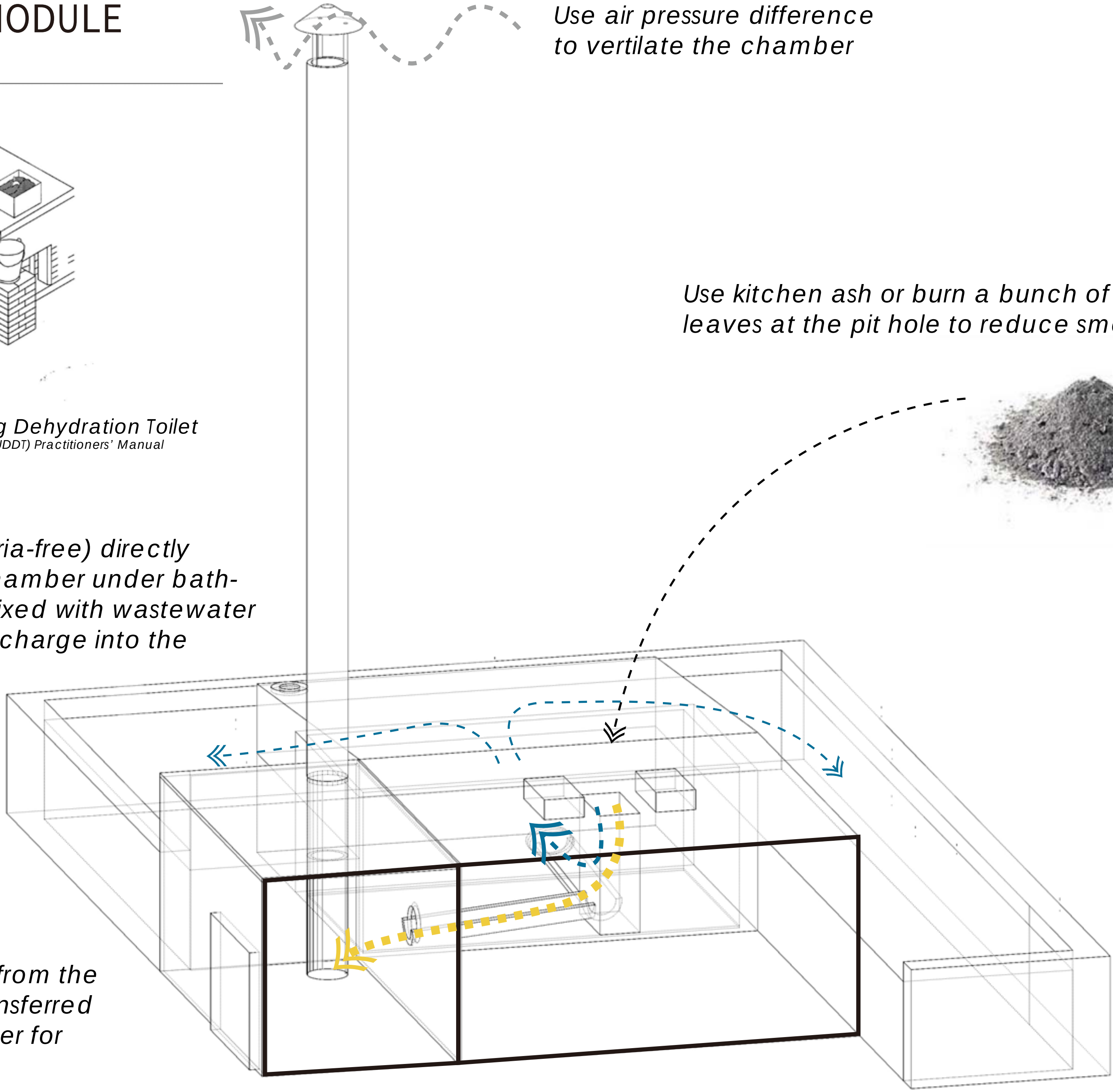


Sample of Urine Diverting Dehydration Toilet
from Urine Diverting Dehydration Toilet (UDDT) Practitioners' Manual

Use air pressure difference to vertilate the chamber

Use kitchen ash or burn a bunch of dry banana leaves at the pit hole to reduce smell

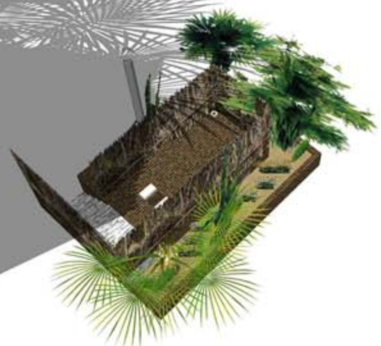
Liquid waste (bacteria-free) directly transferred to the chamber under bath-room, which later mixed with wastewater from shower and discharge into the planting bed

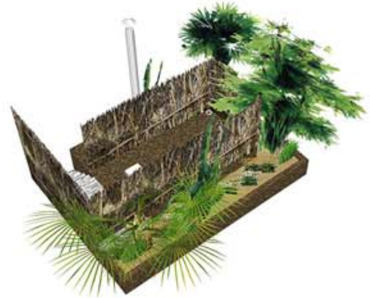


Solid waste divided from the liquid waste and transferred into the side-chamber for temperary storage

5.4 LATRINE MODULE

latrine rendering

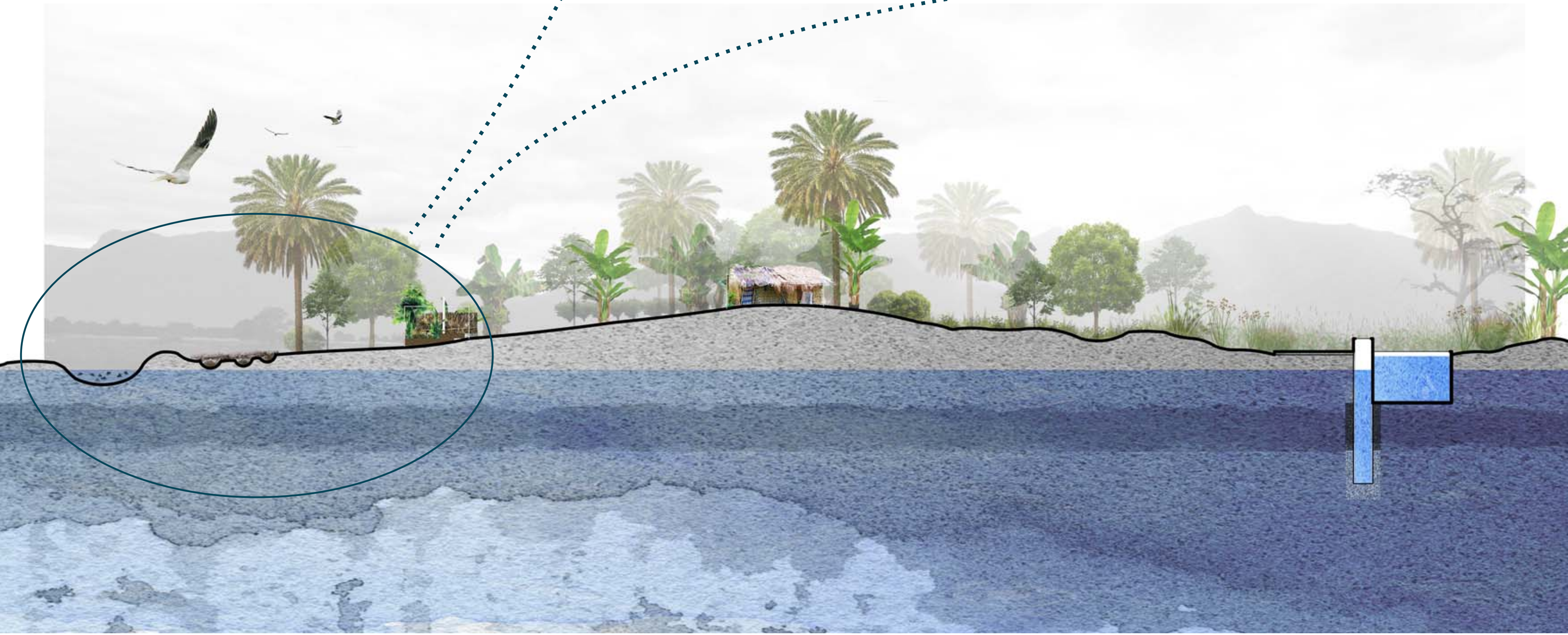




5.5 SEASONAL COMPOST TANKS

RAIN SEASON

fishing farm + scattered shallow compost tanks



5.5 SEASONAL COMPOST TANKS

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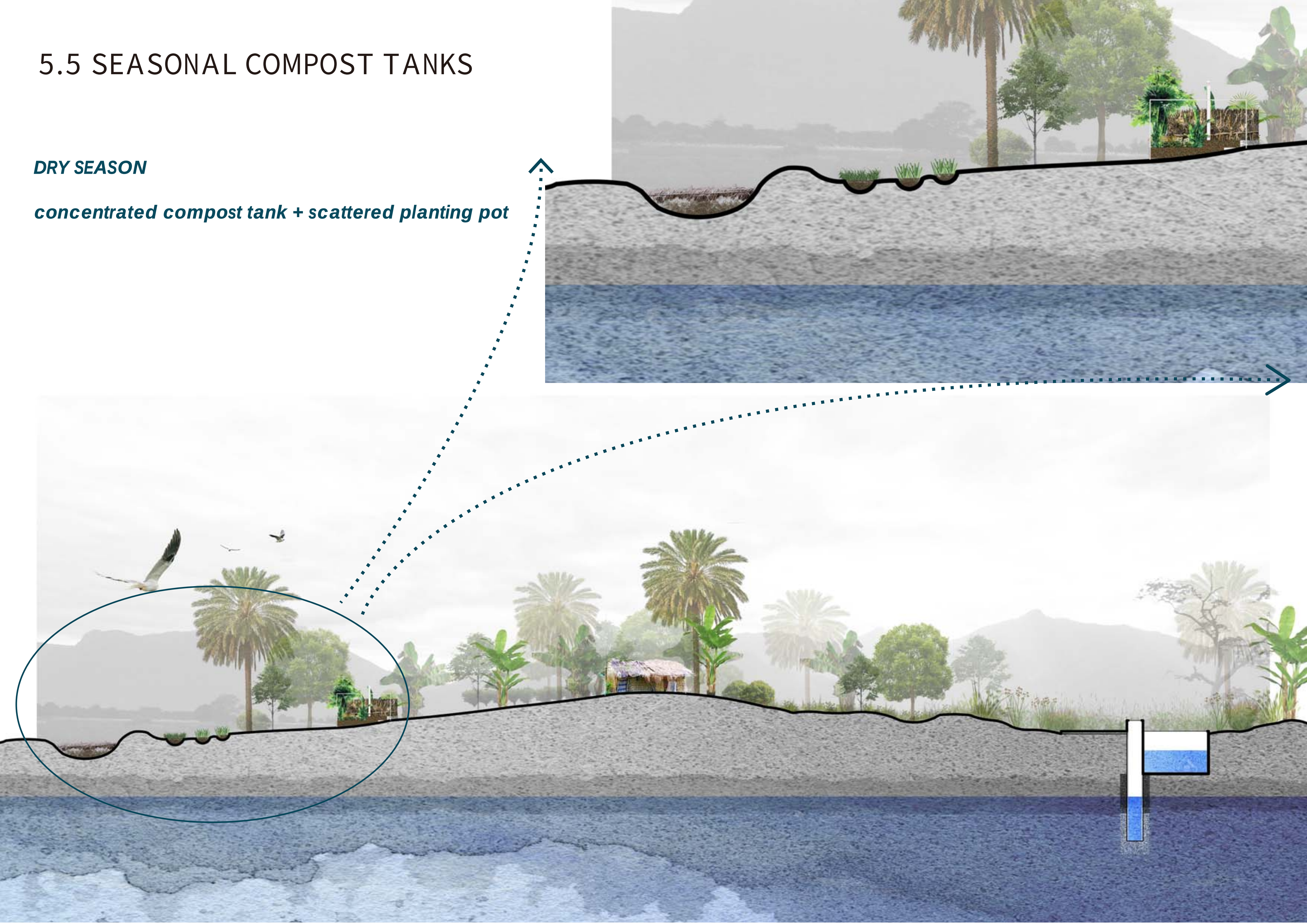
DRY SEASON

concentrated compost tank + scattered planting pot



5.5 SEASONAL COMPOST TANKS

6 CONCLUSION

The proposed project has considered landscape as infrastructural framework that helps rearrange the village's previous land use pattern, and viewing feces as valuable, renewable energy source rather than waste or environmental contamination. With the separation of water facilities and sanitary infrastructure, and with maximum utilization of land and energy, the villagers living in the vicinity of UMNP as well as other parts of Tanzania can benefit from a healthier and more productive rural life with better living condition.

The infrastructural landscape cuts off the pollutant source from latrine, decreasing the spread of water-related diseases and leading to a healthier rural life. In the meantime, the free, renewable home-made fertilizer can be applied to crop fields and increase the productivity, generating more income and sustain the growing population with same areas of agricultural land. At last, due to the sufficient nutrients supplementation, it is unnecessary to conduct shifting cultivation and thus helping to decrease the deforestation rate in adjacent forest areas, sparing more land for conservation and ecotourism.

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THANK
YOU