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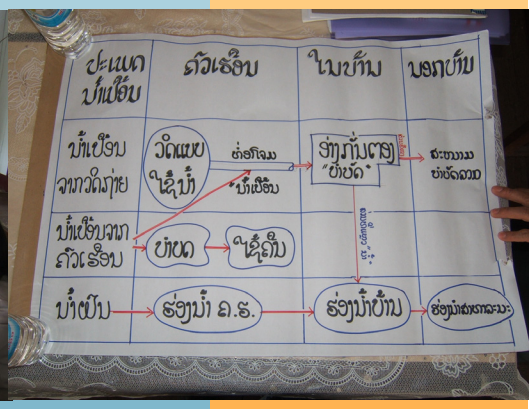

Definition of environmental sanitation system for Hatsady Tai

Outcomes of the HCES project Step 5 and 6, Hatdady Tai, Vientiane, Lao PDR

Public Works and Transport Institute (PTI)

May 2008

dialogue

Contributors/Collaborators

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List of abbreviations

HCES	Household Centred Environmental Sanitation
MCTPC	Ministry of Communication, Transport, Post and Construction (new: MPWT)
MDG	Millennium Development Goals
MOPH	Ministry of Public Health
MPWT	The Ministry of Public Works and Transport
NGPES	The National Growth and Poverty Eradication Strategy
NUoL	National University of Lao PDR
PTI	Public Works and Transportation Institute
STEO-VTE	Science, Technology & Environment Office Vientiane Capital
SWM	Solid Waste Management
UESS	Urban Environmental Sanitation Services
VUDAA	Vientiane Urban Development Administration Authority
WASA	Water Supply Authority
WSSCC	Water Supply and Sanitation Collaborative Council
WREA	Water Resources and Environment Agency, Vientiane Capital

1 Step 5 and 6 of the HCES approach

1.1 Goal and objectives of Step 5 and 6 of the HCES approach

The goal of the Step 5 and 6 of the HCES approach is to identify the range of options for providing those environmental sanitation services which are a priority (as defined in Step 4); to narrow down the options to those which are feasible within the local situation; to calculate indicative costs for the improvements in each sector which the users have prioritized; to determine how different services (i.e. wastewater management, stormwater drainage, solid waste management) can be combined; and to estimate costs for the implementation of the defined UESS. Ultimately, a consolidated UESS plan for the entire project area is developed.

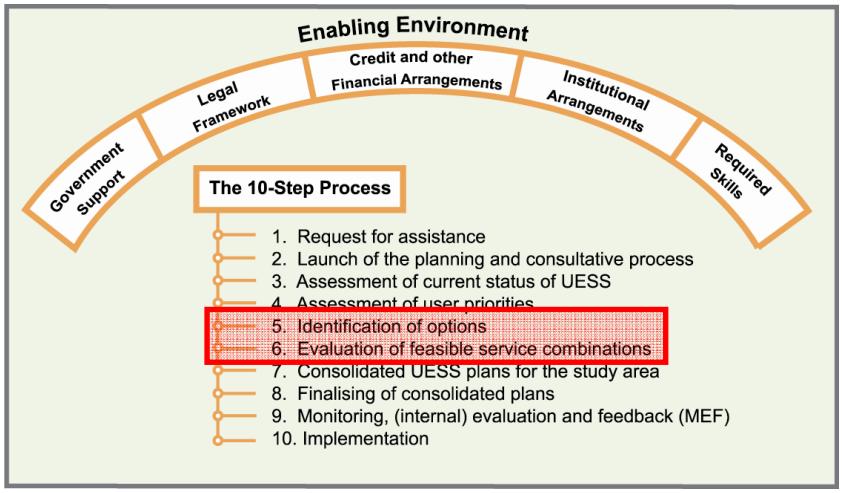


Figure 1: The 10 steps of the HCES approach; Steps 5 and 6 are highlighted

1.2 Methodology

Steps 5 to 6 were conducted jointly. The assessment report (outcome of Step 3), the prioritized environmental sanitation services (outcome of Step 4) and the compendium on sanitation options (draft of Eawag/Sandec, version February 2008) were used as basis for Steps 5 and 6.

The Steps were carried out in several sub-steps:

1. **Expert meeting** (pre-definition of feasible environmental sanitation SYSTEMS in the project area based on drafted compendium on sanitation options and evaluation criteria) - February 9th 2008 (5 hours) - Chapter 2.

2. **Meeting with Village Environmental Unit** (presentation of outcomes of expert meeting, agreement on 1–2 environmental sanitation SYSTEMS that should be further investigated) - February 10th 2008 (4 hours) - Chapter 3.

3. **Tentative design of the UESS plan** by sanitation experts (PTI, Eawag, AIT) for the village (tentative technical design of UESS, estimation of costs, institutional implications) - February to May 2008 - Chapter 4.

The following chapters present in detail the different sub-steps and their outcomes.

2 Pre-definition of feasible UESS SYSTEMS by urban planners and sanitation experts

2.1 Objective

The objective of the expert meeting was to predefine amongst urban planning and environmental sanitation experts which environmental sanitation SYSTEMS are basically feasible in the project area, using the sanitation compendium developed by Eawag/Sandec (drafted version, version February 2008). A system perspective was emphasized, trying as far as possible to avoid discussion on specific sanitation technologies. The discussion was chaired by an international environmental sanitation expert (A. Morel, Eawag). Four representatives from the Public Works and Transportation Institute (PTI) participated in the expert meeting. Seven environmental sanitation systems were evaluated using a range of questions and criteria. The experts agreed on three systems which are basically feasible in the project area.

2.2 Venue and participants

The expert meeting took place on February 9th 2008, 13.00-17.00, at the Public Works and Transportation Institute (PTI). The following experts participated in the expert meeting:

Mr. Antoine Morel (Chairman)	Environmental sanitation expert, Swiss Federal Institute of Aquatic Science and Technology (Eawag), Switzerland
Mrs. Saykham Tammanosouth	Urban planning expert, Public Works and Transportation Institute (PTI), Lao PRD
Ms. Maniseng Douangnoulack	Urban planning expert, Public Works and Transportation Institute (PTI), Lao PRD
Mr. Phouthala Souksakhone	Environmental sanitation expert, Public Works and Transportation Institute (PTI), Lao PRD
Mr. Thongdom Chanthala	Environmental sanitation expert, Public Works and Transportation Institute (PTI), Lao PRD

2.3 Methodology

In an initial step, a set of basic principles were defined which should be followed when evaluating the applicability of systems and basic system layout. In a second step, seven environmental sanitation systems were discussed using the schematic drawings defined in the compendium on sanitation options (see chapter 2.5). The systems were first described by the chairman, followed by a series of questions. A decision was finally taken on the applicability of each system for the study area, and the factors which hinder/favor their applicability.

2.4 Guiding principles, basic assumptions

The following guiding principles were defined as basis for system evaluation and detailed system layout:

1. The existing infrastructure should be integrated as much as possible in the new UESS plans.

2. Cultural barriers should be taken into account, but possibilities to overcome these barriers must be considered before a system is excluded.

3. All inputs (excreta, urine, greywater, stormwater) must be considered.

4. Stormwater and untreated human waste (faeces and urine) should not be mixed.

5. Stormwater drainage is needed anyhow.

6. Blackwater cannot be discharged to the city sewer without treatment (at least primary treatment required).

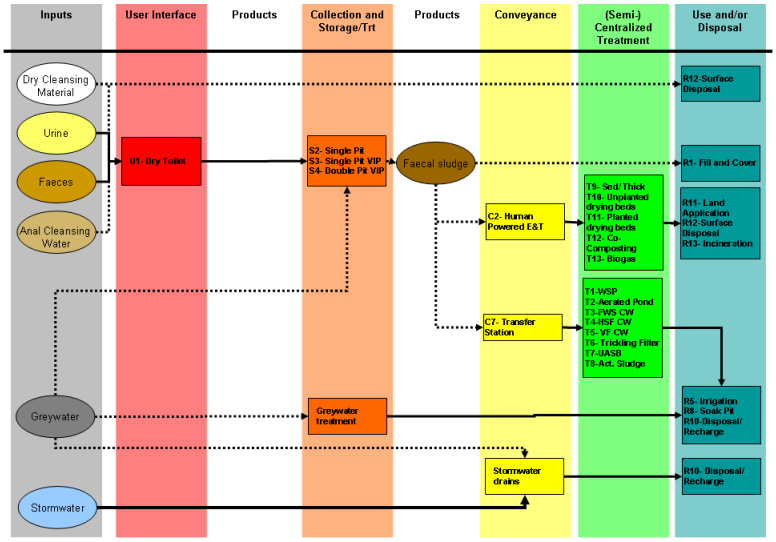
7. Different solutions might be applied in different parts of the village.

8. Infrastructure should be easily accessible for O&M (i.e. avoid drainage channels behind houses which are not accessible).

9. Public toilets are not acceptable. People want to have their private sanitation facilities.

2.5 Applicability of sanitation systems

2.5.1 System 1 – Single pit system



This system is based on the use of a dry-toilet which does not require water; greywater is treated separately. Urine, faeces, anal cleansing water and/or dry cleansing material are disposed in the dry toilet, which is connected to one of the pit technologies. No (or very little) water is used, resulting in faecal sludge which is quite solid and can not be emptied mechanically (i.e. with a vacuum truck) and must be emptied manually. The sludge that is removed is still pathogenic and cannot be reused directly in agriculture, but must be further treated. If there is space to dig a new pit, the faecal sludge can be left in the pit, covered, and taken out of use. The full pit can be planted with a fruit or flowering tree since it will thrive in the nutrient rich environment.

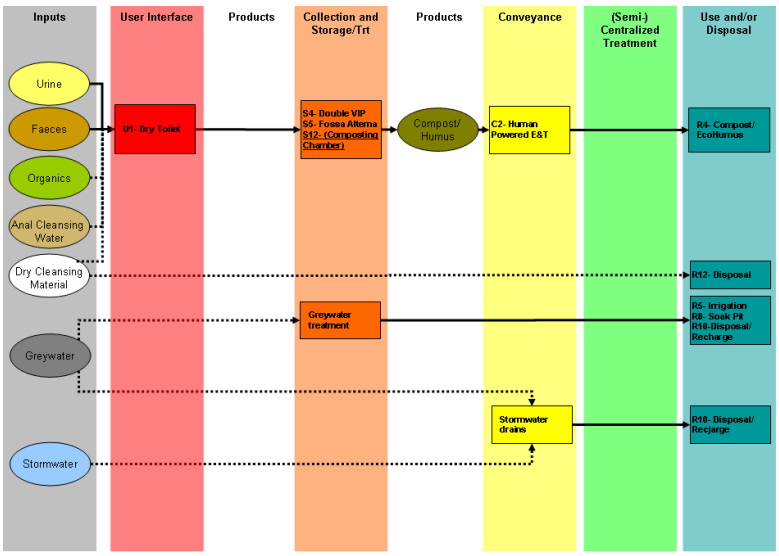
Questions and answers related to System 1:

Question	***Answer***
Is it culturally acceptable to have dry toilet systems?	No - Dry sanitation is not accepted in Vientiane. All people use pour-flush or flush toilets.
Could acceptance be build up through awareness raising?	Very unlikely
Is there enough space for pits?	No space in most parts of the project area.
Is there any treatment capacity on city level for FS?	No. Faecal sludge is dumped in landfills.
Is the groundwater level deep enough to avoid interference with the pits?	No - shallow groundwater
Is there space for onsite greywater treatment?	Space available in parts of the project area only.
Is manual emptying of pits culturally feasible?	Handling with human waste is culturally not acceptable.

Decision on applicability

System 1 is **not applicable** in Hatsady Tai. Main factors hindering its application are (a) lack of space for pits, (b) high groundwater table, and (c) basic reluctance to handle with human waste.

2.5.2 System 2: Alternating double pit system



The concept of this system is that of alternating double pits which produce a dense, compost-like material which is safe to use and apply in agriculture. This system includes a Dry Toilet and therefore, the system is waterless, which means that no water is required, and in fact should not be used; anal cleansing water should be kept to a minimum. There is no need for transport or centralized treatment of the excreta since it is decomposed onsite. The system will produce a nutrient-rich, hygienically-improved, humus-like product that can be used as a soil amendment.

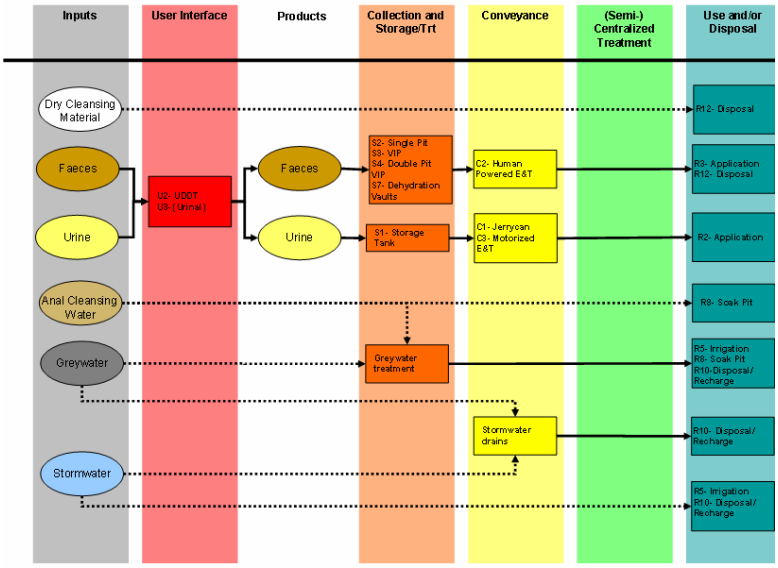
Questions and answers related to System 2:

Question	***Answer***
Is it culturally acceptable to have dry toilet systems?	No - Dry sanitation is not accepted in Vientiane. All people use pour-flush or flush toilets.
Could acceptance for dry toilets and biosolids reuse be build up through awareness raising?	Very unlikely
Is there enough space for twin pits?	No space in most parts of the project area.
Is the groundwater level deep enough to avoid interference with the pits?	No - very shallow groundwater. Above ground vaults would be required.
Is there space for onsite greywater treatment?	Space available in parts of the project area only.
Is handling with human waste culturally acceptable?	Handling with human waste is culturally not acceptable.
Can biosolids be reused locally?	Reuse of human waste (even processed) is culturally not acceptable. No agriculture in the village.

Decision on applicability

System 2 is **not applicable** in Hatsady Tai. Main factors hindering its application are (a) lack of space for pits or vaults, and (b) strong reluctance to handle and reuse human waste.

2.5.3 System 3 – Urine diversion system with urine application or disposal



This system requires a special toilet seat which allows for the separation of urine and faeces. The system is based on the separation of urine, faeces (and anal cleansing water). By separating the different inputs, the faeces dehydrate quickly and be sanitized. Urine, which is generated in relatively small volumes, and is nearly sterile, can be disposed of easily and without risk to the environment, or it can be used as a liquid fertilizer. A separate greywater treatment technology is required in parallel to the urine and faeces handling technologies.

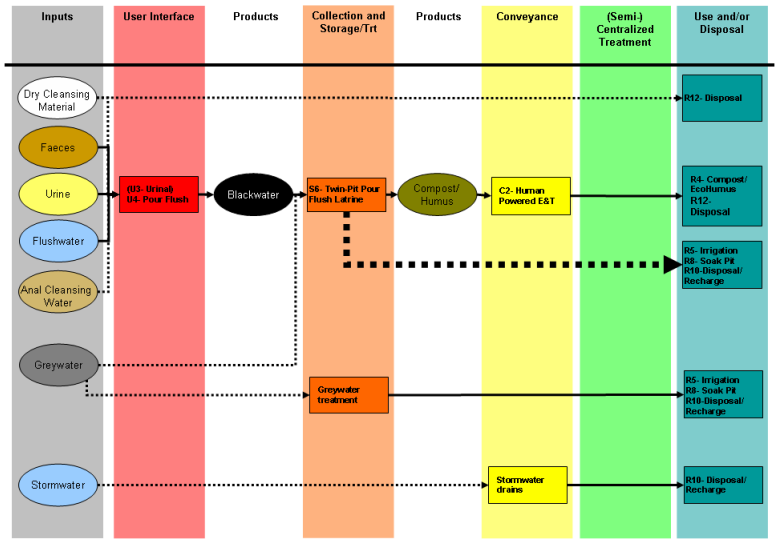
Questions and answers related to System 3:

Question	***Answer***
Is urine diversion culturally acceptable?	Unknown (new technology), but unlikely - Urine is perceived as "dirty".
Could acceptance for urine reuse be build up through awareness raising?	Very unlikely - certainly not in the short term.
Is there enough space for pits or vaults?	There would be enough space for small vaults.
Is it culturally acceptable to have dry toilet systems?	No - Dry sanitation is not accepted in Vientiane. All people use pour-flush or flush toilets.
Is the groundwater level deep enough to avoid interference with the pits?	No - very shallow groundwater. Above ground vaults would be required.
Is there space for onsite greywater treatment?	Space available in parts of the project area only. Rest would have to be discharged to drainage system.
Is handling with human waste culturally acceptable?	Handling with human waste is culturally not acceptable.
Can constant supply of ash/lime/earth be guaranteed?	Unlikely - would have to be introduced from outside the project area.
Can urine and biosolids be reused locally?	Reuse of human waste (even processed) is culturally not acceptable. No agriculture in the village.

Decision on applicability

System 3 is **not applicable** in Hatsady Tai. Main factors hindering its application are (a) strong reluctance to handle and reuse human waste (urine, faeces), (b) lack of reuse opportunities onsite, and (c) basic reluctance towards dry sanitation systems (without flushing water).

2.5.4 System 4 – Pour flush system with twin pits



This is a water-based system that makes use of a Pour-Flush toilet. The system produces a sanitized, humus-like product which can be used as a soil amendment. Because the humus-like product is not liquid, it cannot be removed by a vacuum truck and must be removed manually. Since the system is water-based, greywater and anal cleansing water can be mixed with the blackwater in the twin pits. Thus, no separate greywater treatment system is needed, but where water is scarce, a separate greywater treatment technology can be built. The system is entirely decentralized and all of the products can be treated onsite.

Questions and answers related to System 4:

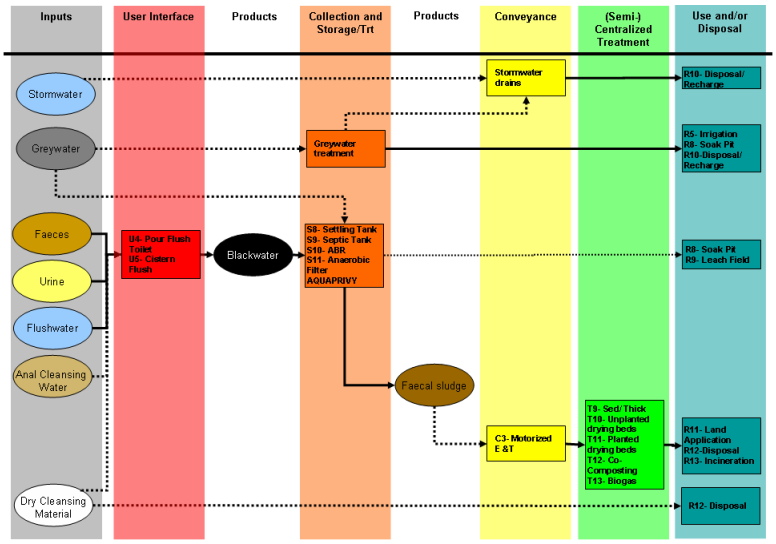
Question	***Answer***
Is pour-flush culturally acceptable?	Yes- the system is already in place (most common toilet system in Vientiane)
Is there enough space for twin pits?	Partly - Limited space in most parts of the project area. Today, systems are operated with one pit (partly above ground)
Is the groundwater level deep enough to avoid interference with the pits?	No - very shallow groundwater. Above ground vaults would be required.
Is there space for onsite greywater treatment?	Partly - Space available in parts of the project area only. Rest would have to be discharged to drainage system or connected to the soak pits.
Can pits be accessed by emptying vehicles?	Partly - access to pits by vehicles is possible in some parts of the village.
Is manual emptying acceptable?	No - handling with human waste is culturally not acceptable

Decision on applicability

System 4 is **applicable** in some parts of Hatsady Tai under certain conditions: (a) if mechanical emptying is possible (accessibility, consistence of accumulated solids), (b) if pits are installed partly above ground (to minimize interference with groundwater and enable infiltration of liquid into soil). Given the fact that the current system is very similar (pour-flush latrines with single soak pit and mechanical emptying), this system should not be excluded but slightly adapted to the local context.

2.5.5 System 5 – System with decentralized blackwater and (semi-) centralized faecal sludge treatment

This system requires a flush toilet (either pour flush or cistern flush) and an onsite collection, storage and treatment technology that is appropriate for storing large quantities of water. The faecal sludge must be removed and transported to a (semi-) centralized treatment technology; the effluent is disposed of on-site (e.g. soak pit). The faecal sludge that is generated in the storage technology must be evacuated by a mechanical emptier; because the sludge is dangerous to handle, it should not be emptied manually.



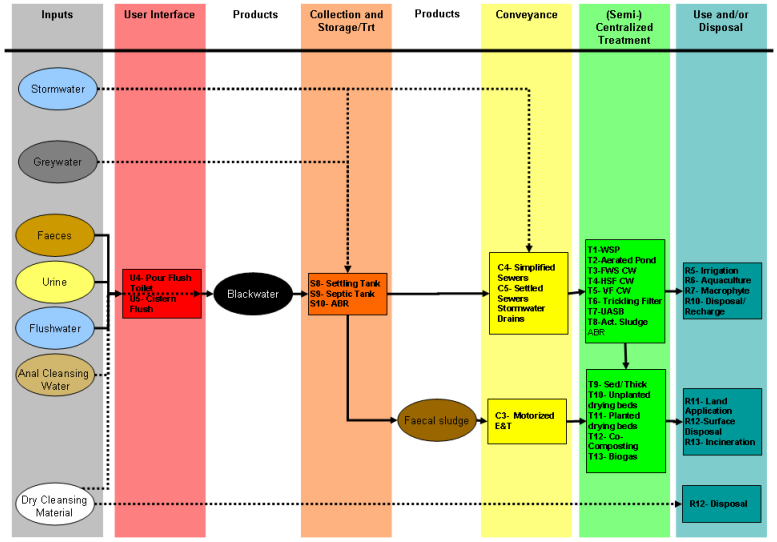
Questions and answers related to System 5:

Question	*Answer*
Is pour-flush culturally acceptable?	Yes- the system is already in place (most common toilet system in Vientiane)
Is there enough space for onsite collection and treatment systems (e.g. septic tanks)?	Partly - Limited space in most parts of the project area. Would have to be constructed in house basement. Some households are already equipped with settling tanks, septic tanks and soak pits.
Is the groundwater level deep enough to avoid interference with soak pits or leach fields?	No - very shallow groundwater. Groundwater contamination cannot be excluded.
Can onsite collection systems be accessed by emptying vehicles?	Partly - access by vehicles is possible in some parts of the village.
Are leach fields applicable?	Unlikely - only few households could install a leach field next to their onsite collection system.

Decision on applicability

System 5 is **applicable** in very few parts of Hatsady Tai where (a) there is enough space for local infiltration of pre-treated wastewater, and (b) access to onsite storage and treatment systems can be guaranteed. This system is therefore not excluded, but will most probably not be applied.

2.5.6 System 6- Settled sewerage system with (semi-) centralized treatment



This system is characterized by the use of a household-level technology to remove settleable solids from the blackwater, and a simplified or settled sewer system to transport the effluent to a (semi-) centralized treatment facility. An interceptor tank is required before the effluent enters the sewer. Faecal sludge that accumulates both at the household level and at the centralized treatment facility must be transported and treated separately. The effluent that is produced at the centralized facility can be used beneficially or discharged after suitable treatment.

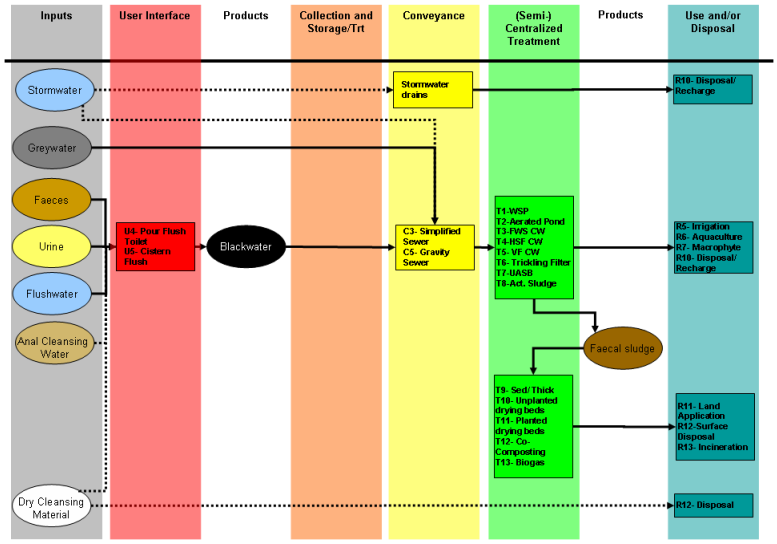
Questions and answers related to System 6:

Question	***Answer***
Is there enough space for onsite collection and treatment systems (e.g. septic tanks)?	Partly - Limited space in most parts of the project area. Would have to be constructed in house basement. Some households are already equipped with settling tanks or septic tanks.
Can onsite collection systems be accessed by emptying vehicles?	Partly - access by vehicles is possible in some parts of the village. Would require a small emptying vehicle.
Is there enough space and hydraulic gradient to construct a simplified sewer network?	Yes - some buildings would have to be slightly modified to enable construction work.
Is there enough space for semi-centralised post-treatment of wastewater?	Limited - semi-centralised post-treatment is only possible in buried systems (under roads). There is not enough space for systems such as constructed wetlands or ponds.
Is connection to higher level (district) transport and treatment system possible?	Yes - the village sewer network could be connected to the higher level sewer network, if wastewater is pretreated.

Decision on applicability

System 6 is **applicable** in Hatsady Tai where access to onsite storage and treatment systems can be guaranteed. This system is especially suited for households with settling/septic tanks already installed. Land for semi-centralised treatment of wastewater is available, but requires treatment systems which can be installed under ground (under roads).

2.5.7 System 7 – Sewerage with (semi-) centralized treatment



This system is a water-based sewer system in which blackwater is transported to a centralized treatment facility. There is no onsite collection or storage. Depending on the sewer type and management structure (simplified vs. gravity, city-run vs. community operated) there will be varying degrees of operation or maintenance responsibilities for the homeowner. Greywater is co-treated with the blackwater and helps prevent solids from accumulating. Faecal sludge treatment is also the responsibility of the same management group, although the processing and disposal may be outsourced to an external company.

Questions and answers related to System 7:

Question	***Answer***
Is there enough space and hydraulic gradient to construct a simplified sewer network?	Yes - some buildings would have to be slightly modified to enable construction work.
Is there enough space for semi-centralised post-treatment of wastewater?	Limited - semi-centralised post-treatment is only possible in buried systems (under roads). There is not enough space for systems such as constructed wetlands or ponds.
Is connection to higher level (district) transport and treatment system possible?	Yes - the village sewer network could be connected to the higher level sewer network, if wastewater is pre-treated.
Can current household systems (toilet systems) be easily connected to a sewer network?	Yes - but some private toilets need to be rebuilt to enable connection to sewer.

Decision on applicability

System 7 is **applicable** in Hatsady Tai. This system is especially suited where access to private toilets is difficult. Land for semi-centralised treatment of wastewater is available, but requires treatment systems which can be installed under ground (under roads). Treated wastewater can be discharged to the primary sewer network adjacent to the project area.

2.6 Conclusion, methodological considerations

Out of the seven UESS systems discussed, only three (Systems 5, 6 and 7) were perceived as applicable to the project area. One system (System 4) was perceived as basically applicable, but only in exceptional cases where local infiltration trenches can be installed.

The main factors influencing the applicability of systems include: (a) a strong cultural barrier towards handling and reusing of human waste; (b) limited space for onsite systems; (c) strongly hindered accessibility to onsite systems; (d) lack of reuse opportunities within reasonable distances; (e) possibility to connect to the higher level infrastructure network; and (f) strong preference for water based systems or rejection of dry sanitation technologies.

The SYSTEM approach was perceived by all participants as useful and straightforward. In order to facilitate the discussion, systems might be adapted to the local context (or even excluded) before the expert consultation meeting. Some of the systems appeared to be very similar (e.g. system 1 and system 2; system 5 and system 6) and might be combined in one system to speed up the process and avoid confusion. Despite trying to keep a system approach, discussion on specific technologies could not be avoided. The main challenge consisted in balancing system and technology focus. It could also be observed that experts tend to prioritize systems which are familiar to them. Innovative and unconventional concepts such as urine diversion are unlikely to be considered appropriate unless the contrary can be proven. This would require demonstration projects, awareness raising and information campaigns for all relevant stakeholders (including local environmental sanitation experts). Given the time pressure and the limited human and financial resources, this was not possible in this project, and will most probably not be feasible elsewhere unless financed and supported by international funding agencies.

3 Meeting with Village Environmental Unit (VEU)

3.1 Objective

The objective of the meeting was to present and discuss the outcomes of the expert meeting (see chapter 2) with the Village Environmental Unit (VEU), to agree on a set of basic working principles, and to select 1–2 environmental sanitation SYSTEMS that should be further investigated (more detailed planning, cost estimation, O&M requirements etc.).

The meeting was the first official meeting of VEU. Therefore, an important objective of the meeting was to create an environment of trust and complicity between the project coordinator (PTI), the Naiban and the VEU, and to increase awareness of the VEU members on the important role they play for the project.

3.2 Venue and participants

The VEU meeting took place on February 10th 2008, 14.00-17.00, at the Village office of Ban Hatsady Tai. Out of the 10 elected VEU members, only 5 could participate in the meeting. The following people participated in the meeting:

Mrs. Khamvanh	Naiban (village head), Head of the Village Environmental Unit (VEU)
Mr. Chankeo	Community member, head of security unit of Hatsady Tai, member of the VEU
Mr. Tienxay	Community member, member of security unit of Hatsady Tai, member of the VEU
Mr. Khamchaleun	Representative of the Lao Revolution Party, member of VEU
Mr. Mixay	Head of village unit, member of VEU
Mr. Antoine Morel	Environmental sanitation expert, Swiss Federal Institute of Aquatic Science and Technology (Eawag), Switzerland
Mrs. Saykham Tammanosouth (Chair)	Project coordinator, Urban planning expert, Public Works and Transportation Institute (PTI), Lao PRD
Ms. Maniseng Douangnoulack	Project manager, Urban planning expert, Public Works and Transportation Institute (PTI), Lao PRD
Mr. Thongdom Chanthala	Project manager, Environmental sanitation expert, Public Works and Transportation Institute (PTI)

3.3 Methodology

The meeting was facilitated by one chairperson (Mrs. Saykham Thammanosouth).

The meeting started with a recall of (a) the terms of reference of the VEU, (b) the main findings of the UESS assessment (outcome of Step 3) and (c) the prioritized UESS as defined by the community (outcome of Step 4).

In a second step, the working principles and basic assumptions pre-defined by the expert group (see chapter 3.4.2) were discussed, revised and approved.

In a third step, the expert group presented the pre-selected UESS systems and the reasons for inclusion or exclusion of specific systems. For that purpose, simplified systems drawings were prepared in Lao language (see chapter 3.4.3). These drawings were used for the following discussion, which resulted in the selection of 2 feasible systems.

In a last step, the framework and responsibilities for the following activities were defined.

3.4 Outcomes of the meeting

3.4.1 Discussion on Terms of Reference VEU, main findings assessment report, UESS priorities

This meeting was the first meeting of the VEU after its election. Therefore, Mrs. Saykham Thammanosouth recalled the role of the VEU in project planning, implementation and management after completion.

The **terms of reference (ToR)** were discussed and approved by the VEU and the Naiban:

- Actively participate in the planning of UESS for Hatsady Tai (core member of the project coordination team)
- Ensuring community participation during all phases (planning, implementation, O&M)
- Oversee and coordinate implementation of UES infrastructure
- Certify satisfactory completion of works
- Own assets, establish O&M system and take full responsibility for O&M
- Mobilizing community contributions for:
  - contribution to capital costs of projects;
  - operation and maintenance costs;
- Collect required contribution in cash or kind from the community

- Maintaining the asset after completion with collection of community cost contributions.

The VEU also reconfirmed the priorities as defined by the community, namely:

- Stormwater drainage
- Solid waste management
- Sanitation (toilet wastewater)

An additional issue mentioned by the VEU was Accessibility - Roads should also be improved (to maximize benefit of drainage system, to guarantee access to houses for fire fighters). Given the limited financial resources, additional funds have to be mobilized. Funding sources could not be identified yet.

3.4.2 Discussion on working principles and basic assumptions guiding the system selection

Basic principles and basic assumption underlying the evaluation of environmental sanitation systems were presented by Mrs. Saykham Thammanosouth. The following guiding principles and basic assumptions were approved by the VEU:

Guiding principles

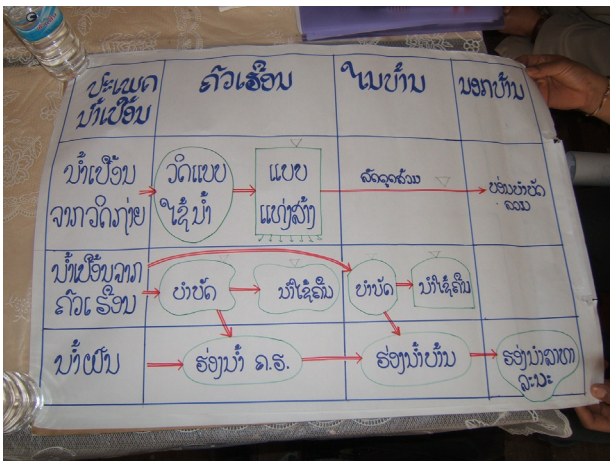
1. Existing infrastructure should be integrated as much as possible in the new UESS plans.
2. Cultural barriers should be taken into account, but possibilities to overcome these barriers must be considered before a system is excluded.
3. The system must account for all sanitation inputs (excreta, urine, greywater, stormwater).
4. Stormwater and untreated human waste (faeces and urine) should not be mixed (defined in Lao legislature).
5. Blackwater cannot be discharged to the city sewer without treatment (at least primary treatment required).
6. Different solutions might be applied in different parts of the village.
7. Infrastructure should be easily accessible for O&M (i.e. avoid drainage channels behind houses which are not accessible).

Basic assumption underlying the SYSTEM selection

1. Stormwater drainage is needed anyhow in the village.
2. Handling with human waste (i.e. manual emptying of onsite sanitation systems) is culturally very difficult and will certainly be rejected by the community.
3. Reuse of human waste (urine, biosolids) in agriculture is culturally not acceptable. People will neither use human waste as fertilizer, nor consume products fertilized with human waste.
4. Awareness raising initiatives have little chance of success in increasing acceptance and demand for human waste reuse.
5. The idea of having shared toilets is strongly rejected by the community. People are used to have private toilets, and want to have their private toilets in future.
6. There is no significant agricultural activity in the village.
7. Access to houses is limited for motorized vehicles (4 wheels) in most parts of the village.
8. Space for treatment systems within the project boundaries is limited. The biggest area does not exceed 200m2.

3.4.3 Evaluation of environmental sanitation systems

Mr. Thongdom Chanthala presented the outcomes of the expert meeting (chapter 2) to the VEU members. For that purpose, schematic drawings were prepared of the three systems that were considered feasible by the expert group (see Pictures below). For each of the three feasible systems, a simplified flow-diagram and a schematic plan were developed in Lao language.



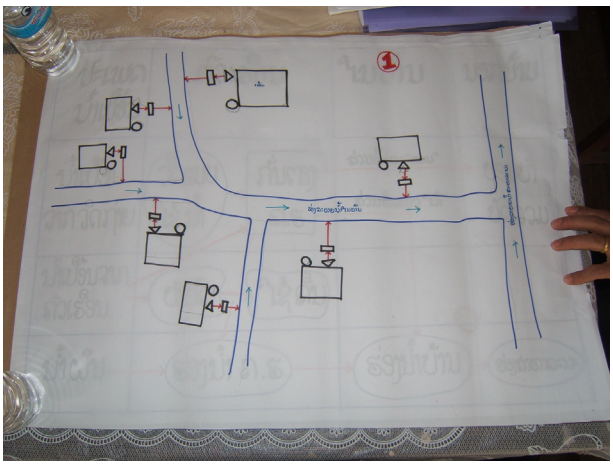


Photo 2: Schematic drawings of adapted system 4 – Pour flush system with (twin) pits. Left: Flow-Diagram, right: schematic layout (photo: A. Morel).

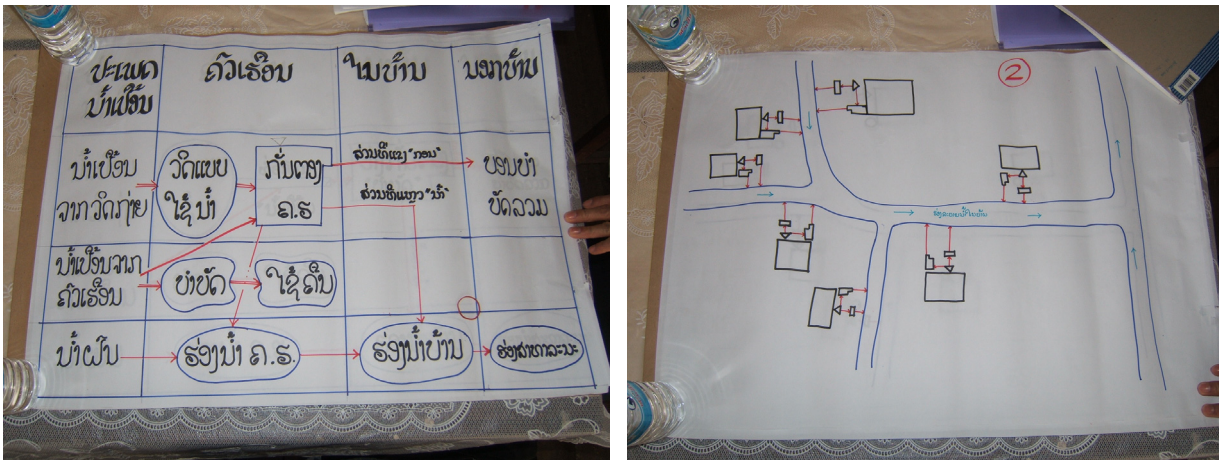


Photo 3: Schematic drawings of adapted system 6 – Settled sewerage system with (semi-) centralized treatment. Left: Flow-Diagram, right: schematic layout (photo: A. Morel).

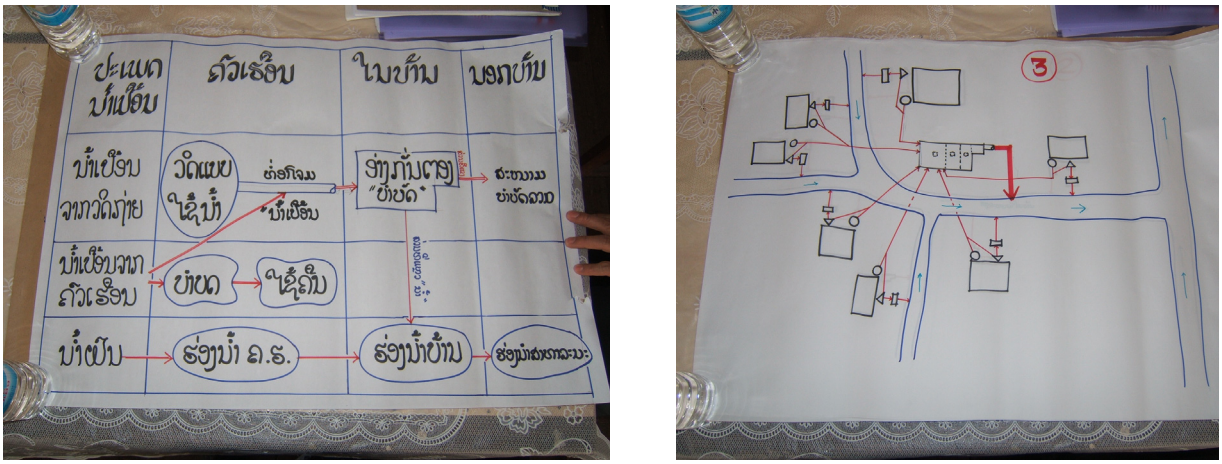


Photo 4: Schematic drawings of adapted system 7 – Sewerage with (semi-) centralized treatment. Left: Flow-Diagram, right: schematic layout (photo: A. Morel).

Feedback from the VEU (Village Environmental Unit)

1. The three systems are basically feasible, but system 7 is strongly supported ("we want communal septic tanks").

2. Very few of the existing cesspit systems are working properly. Main problem is that the cesspits cannot be accessed by emptying trucks, and that households are not willing to empty their cesspits manually. As a result cesspits overflow and discharge to open drainage. System 4 should only be applied where existing cesspits are in good condition and accessible for emptying vehicles.

3. System 6 might be applied where septic tanks already exist (16 septic tanks are currently in operation in the project area)

4. Land for communal septic tanks (or similar technologies) is available, but the land belongs to private households. The project team has to negotiate with these households to see if they are willing to provide their land.

5. The construction of the drainage network is a good opportunity to improve the road network within the village. The VEU and the Naiban will try to convince specific homeowners to move parts of their houses to improve accessibility.

3.4.4 Decisions, next steps, responsibilities

A **detailed survey** of household toilets, bathrooms, kitchen and onsite sanitation is required to find out: (a) which toilets and cesspits are in good condition or which need to be improved/replaced; (b) where are the sources of black- and greywater and where does this water currently flow; (c) the state of onsite treatment systems such as cesspits and septic tanks. *Responsibility: PTI.*

Areas should be identified where semi-centralised wastewater treatment system could be implemented. *Responsibility: PTI with VEU.*

It might make sense to **include additional areas** which are currently outside the defined project boundaries but which discharge water (stormwater, wastewater) into the project area (mainly houses in the North). *Responsibility: PTI* (re-assess the water flows in the village, and the origin of this water).

The drainage system should be connected to the **higher level drainage network** in the South of the project area. VUDAA should be contacted to get approval to connect to the drainage network. *Responsibility: PTI.*

Infrastructure must be accessible. Drainage channels behind or under houses which are currently not accessible and therefore in very bad conditions should be removed. Whenever possible, drainage channels should be laid aside roads.

Improvements on household level (e.g. toilets, connection to sewer and drainage) must be financed by the house owners. The challenge will be to convince households to invest money in household infrastructure. *Responsibility: All.*

Negotiation **with building owners** which might be affected by construction works must be initiated. *Responsibility: Naiban and VEU.*

A **first drainage and wastewater management infrastructure plan** should be drafted following the system template No. 7. The plan should also include construction cost estimates. *Responsibility: PTI.*

A **survey** must be conducted to re-assess the **topography** of the area, with special focus on road, drainage and toilet elevation. *Responsibility: PTI.*

3.4.5 Observations, lessons learnt

The simplified system drawings were very useful as discussion basis. The flowcharts were less used than the schematic layout drawings, which are easily understood by non-experts. The risk of the schematic layout drawings is that the discussion very quickly diverts to specific technologies (i.e. communal septic tank).

The high number of absentees (5 out of 9 VEU members participated in the meeting) was surprising. Reasons might include: (a) VEU members do not recognize the crucial role they play for the project; (b) the project is not a first priority for some members; (c) communication channels between PTI, Naiban and VEU are not working well; (d) timing of the meeting was not suitable. The issue must be tackled as soon as possible; project ownership by the VEU is of highest importance for project success.

Photo 5: First meeting of the Village Environmental Unit

Aspects related to financial costs or operation and maintenance requirements were not included in that discussion. Systems were purely evaluated from a technical feasibility point of view. This was not fully understood by the Naiban and the VEU, which considered the decision on system selection as final.

Project ownership is not yet with the VEU and the Naiban. PTI and Eawag still have the full responsibility. The consultation and involvement of VEU and Naiban in the planning process is partly perceived as excessive by the participants; both VEU and Naiban tend to act as beneficiaries rather than members of the project coordination committee.

4 First draft of environmental sanitation plan

4.1 Objective

The goal of this step was to develop a first draft of an infrastructure plan for stormwater drainage and domestic wastewater management, based on the selected systems 6 and 7 (see chapter 3). The specific objectives included:

1. To identify location and status of existing cesspits and septic tanks in the project area.
2. To identify current water flows within project boundaries (stormwater, wastewater).
3. To identify sub-system areas (similar conditions, priority areas).
4. To define possible drainage network lining.
5. To identify areas where semi-centralised wastewater treatment systems could be constructed.
6. To identify possible connection points with higher level infrastructure.
7. To identify possible sewer lining.
8. To determine different types of drainage systems and communal wastewater treatment systems that might be applied in the project area.
9. To estimate costs for the different sub-systems.
10. To produce maps and blueprints of the different sub-components.

4.2 Methodology

The activities related to the above-mentioned objectives were conducted by the project coordination team at PTI with support of civil engineers at PTI. A detailed survey of the household infrastructure and the drainage system was conducted through direct observations. Costs were estimated based on experiences from other similar infrastructure projects in Lao PDR.

4.3 Detailed survey of sanitation, access, open space

4.3.1 Status of existing cesspits and septic tanks

16 Households are equipped with a septic tank (see figure below). The septic tanks are in acceptable conditions (no leakage detectable). The septic tanks are currently discharging to the earth drainage in the village.

The other households are equipped with cesspits. Blackwater is partly infiltrating into the soil, excess water is discharged to the open drainage channel. 24 cesspits are in very poor conditions (see figure below).

Greywater is directly discharged to the open drainage channel.

Figure 2: Household sanitation infrastructure in Hatsady Tai

Photo 6: Some of the cesspits in the village are in bad condition

4.3.2 Drainage pathways and areas

Main surface water drainage pathways run from North-East to South-West (see figure below). Most drainage channels are open earthen channels. Three sections of the drainage channel run under houses and are not accessible. Other sections are very difficult to access because they run behind houses.

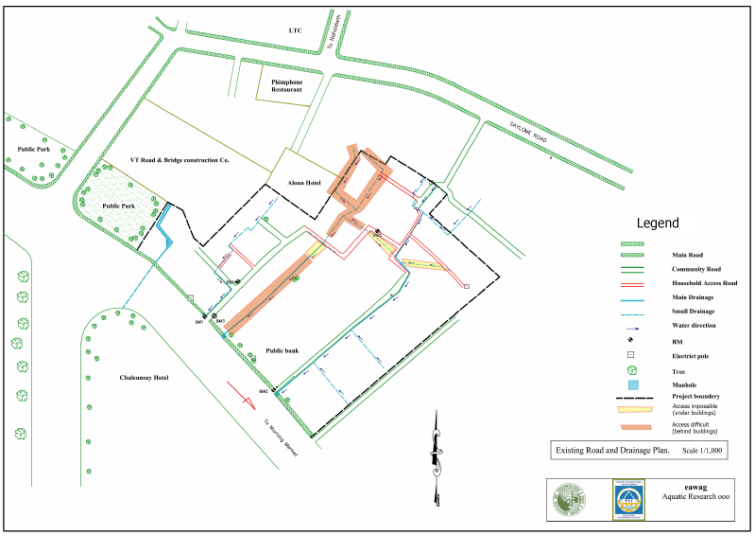


Figure 3: Main drainage pathways; accessibility of drainage network

8 drainage areas with specific drainage pathways can be distinguished. 7 areas have clear pathways; the central part of the village drains in different directions (see Figure 4). Connection to the higher level drainage network (city sewer) is possible at four points on the main road in the South of the project area.

Figure 4: Main drainage areas, possible connection points to higher level drainage network.

4.3.3 Accessibility

Residents access their houses via three entry points (see figure below). Houses in the West are easily accessible by 4 wheels vehicles. Access to houses in the East is possible with 4 wheels vehicles, but more difficult (the alley width does not exceed 3m). Trucks cannot access this area. The village centre cannot be accessed by 4 wheels vehicles.

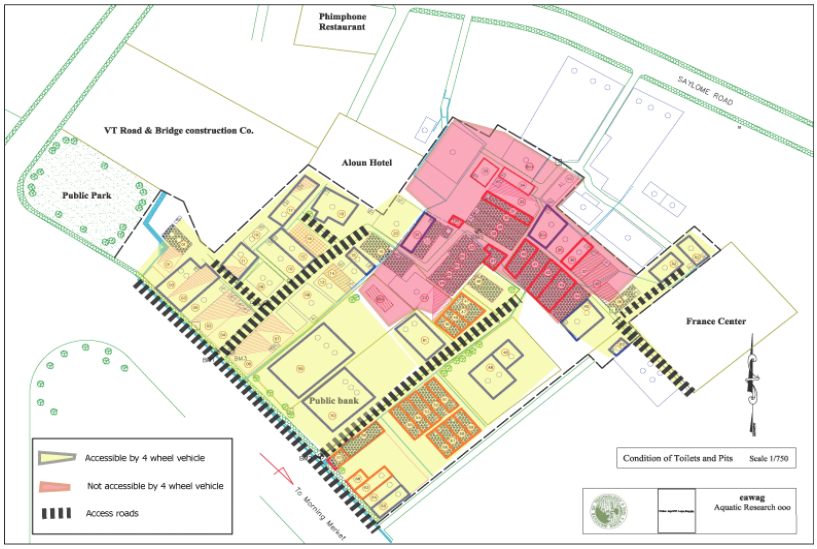


Figure 5: Access to the village (roads)

4.3.4 Open space

Open space is very limited within the project boundaries. Four open spaces where identified with a surface area of 20m2 or more which could be suitable for the installation of semi-centralised treatment systems (see Figure 6).

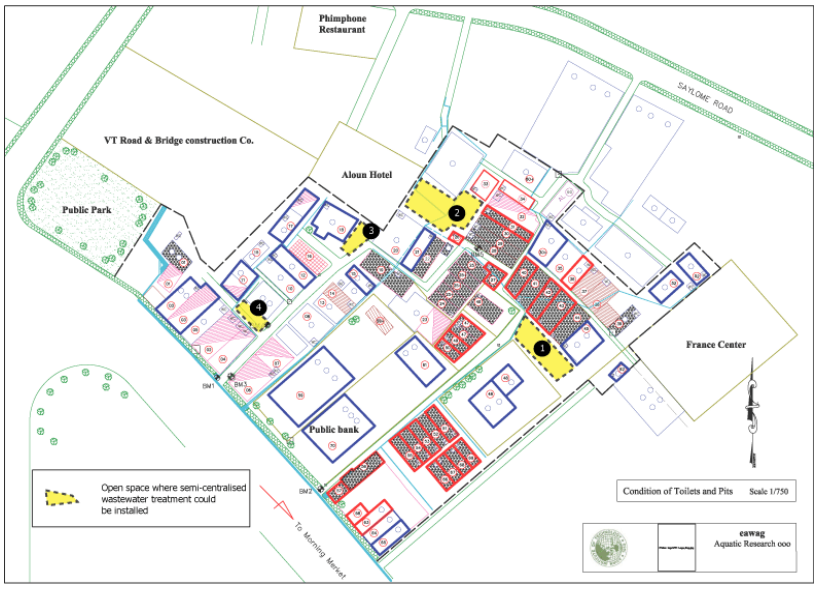


Figure 6: Open spaces in the project area

No	***Specificities***	***Picture***
1	Large open space (150m2) in the East of the project area. Accessible via narrow (2.5-3.0m) alley. Private land owner	
2	Large area (200m2) in the North of the project area. Access difficult. Would require enlargement of access road from the South or access via Aroon hotel. Private land owner	
3	Small area (20m2) in the village centre. Easily accessible via main access road from the South. Government owned.	
4	Medium-sized (40m2) area behind the community hall. Area is access road to houses behind community hall (only suitable for under-ground treatment systems) Easily accessible via main access road from the South. Government owned.	*No picture available*

4.4 Draft of infrastructure plans

4.4.1 Drainage system

The basic concept consists of removing non-accessible drainage channels and to place new drainage lines along the main access roads. The main drainage is laid aside the roads (one site only) to avoid traffic loads. The two main drainage lines shall be connected to the higher level drainage channel at two points (see Figure 7).

A rectangular cross-section is suggested with movable covers (concrete or hard wood) to facilitate access for maintenance (see Figure 8). Whenever possible, the drainage will be kept open (easy maintenance, reduced costs). A brick construction is suggested to minimize the costs. Simple man holes will be installed at direction changes.

The drainage network will convey stormwater and pre-treated wastewater (septic tank effluent, effluent of semi-centralised treatment systems) only. Greywater may be discharged to the drainage channel in case connection to the simplified sewer network is not feasible or too expensive. The total length of the drainage network amounts to 500 meters.

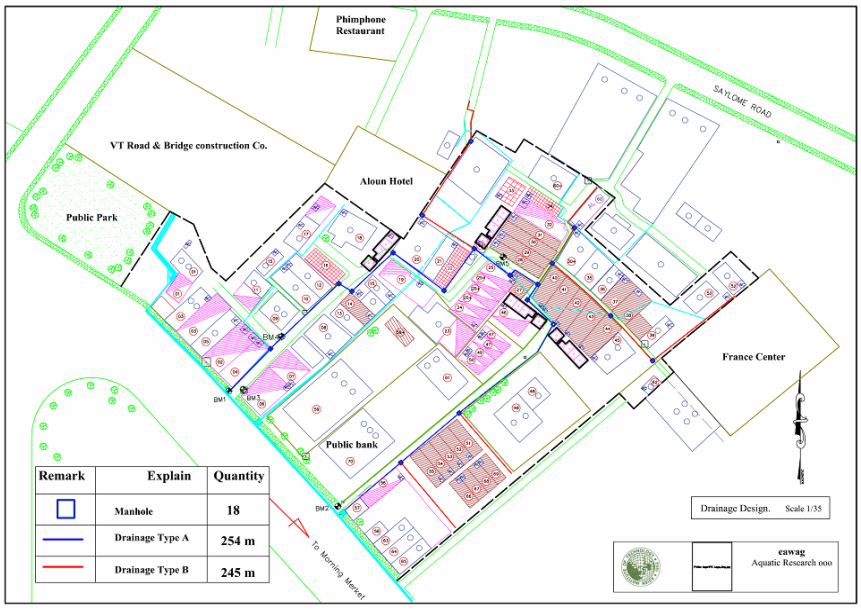


Figure 7: Suggested drainage network lining in the project area

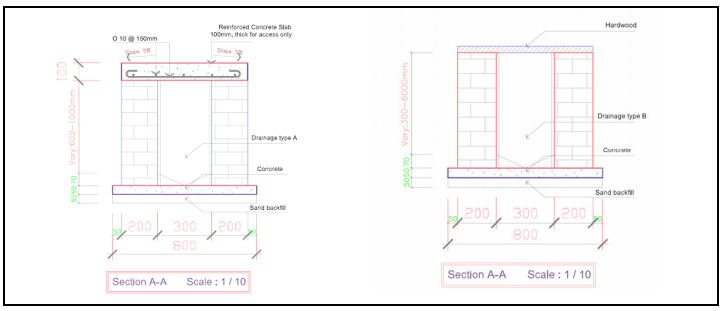


Figure 8: Suggested cross section of drainage network

4.4.2 Wastewater collection and treatment system

The basic concept of the wastewater collection and treatment system consists of transporting effluent from onsite sanitation systems (effluent from cesspits and septic tanks plus household greywater) via a simplified sewer network to 2 community wastewater treatment systems (see Figure 9 and Figure 10). An anaerobic treatment system is suggested to minimize operational costs and management requirements (septic tank, anaerobic baffled reactor or anaerobic filter). Effluent from the community treatment systems will be discharged to the drainage network.

Two separate sewer networks shall be installed, laid a very shallow depths (20–30 cm) to minimize construction costs. This is feasible given the absence of traffic loads (no access for four-wheel vehicles). PVC pipes with a diameter of 10–15 cm will be used. Simple control and connection chambers will be installed, enabling the maintenance of the sewer system.

It is suggested to place the community treatment systems at the open spaces No. 1 and 2 in the project area (see Figure 6).

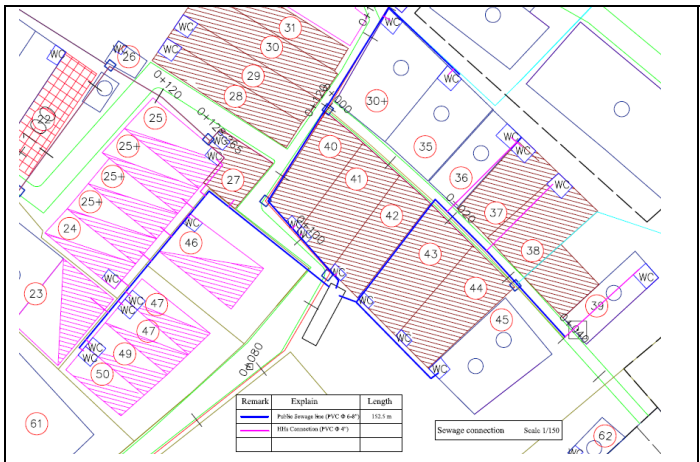


Figure 9: Wastewater collection and treatment system No. 1.

The sewer network connects 23 households to a community wastewater treatment system located on private ground. The treatment system can be accessed via a gravel road.

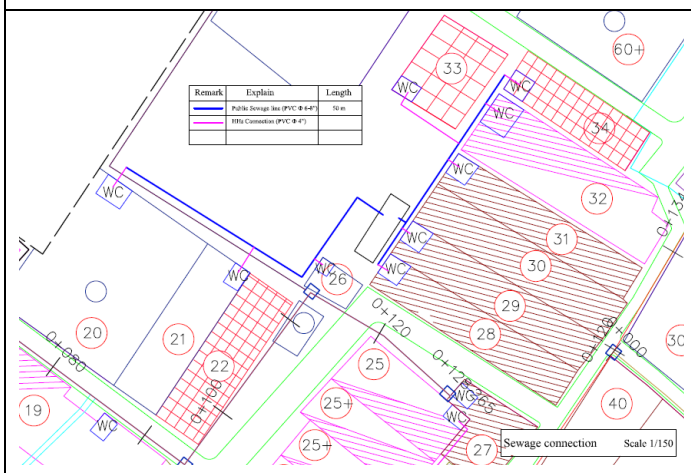


Figure 10: Wastewater collection and treatment system No. 2.

The sewer network connects 12 households in the North-east of the village to a community treatment system located on private ground. Access will need to be established (removal of fence, access path)

The following 3 treatment systems are considered as community wastewater treatment systems: a state-of-the-art septic tank that can be upgraded/modified to an anaerobic baffled reactor (*Figure 11*), a low-cost septic tank using concrete rings (*Figure 12*, for small wastewater amounts only), and a combined septic tank with anaerobic filter (*Figure 13*).

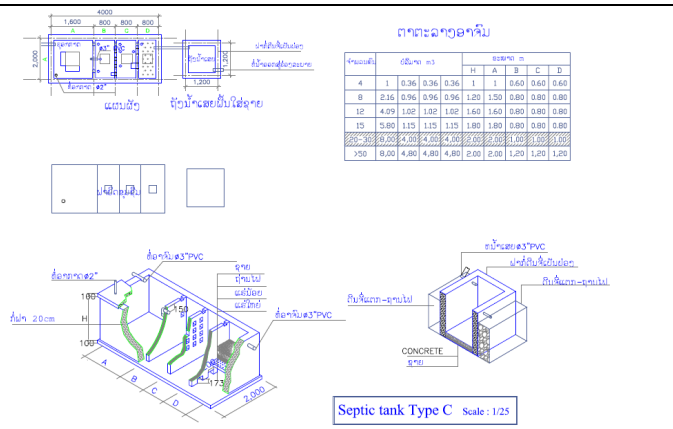


Figure 11: State-of-the-art septic tank, ABR

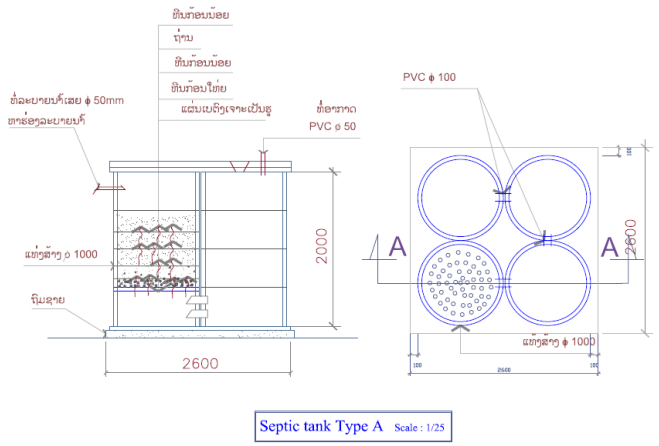


Figure 12: low-cost septic tank using concrete rings

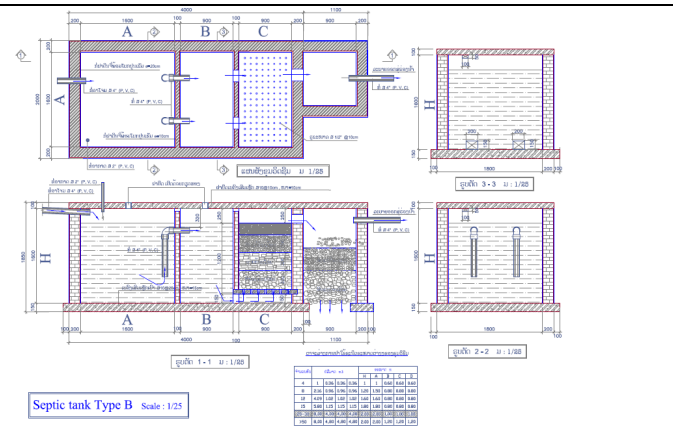


Figure 13: combined septic tank with anaerobic filter

4.5 Cost estimation

Preliminary cost estimations were established for the 3 drainage lines and the wastewater management system (sewer line and community treatment systems). The total costs for the implementation of the liquid waste component (storm- and wastewater management) amount to 27,000 USD. Estimated costs are presented in Table 1.

Table 1: Preliminary cost estimation for liquid waste management component

IMPLEMENTATION COSTS	*Material*		*Labor*		*Material & Labor*	
	Kip	*USD*	*Kip*	*USD*	*Kip*	*USD*
Drainage type A	35'483'825	4'079	22'652'649	2'604	58'136'474	6'682
Drainage type B	32'005'825	3'679	22'889'470	2'631	54'895'295	6'310
Drainage type C	14'647'550	1'684	8'286'688	952	22'934'238	2'636
Sewer	29'598'250	3'402	3'231'250	371	32'829'500	3'774
Anaerobic treatment systems	59'196'500	6'804	6'462'500	743	65'659'000	7'547
Total	**170'931'950**	**19'647**	**63'522'556**	**7'301**	**234'454'506**	**26'949**

The budgeted material costs slightly exceed the expected expenditures as originally defined in the PAMS proposal (19,000 CHF). Budgeted labor costs are very much on the lower side, and actual costs will depend on the bidding companies. It is expected the labor costs can be covered by the PAMS project and by community labor.