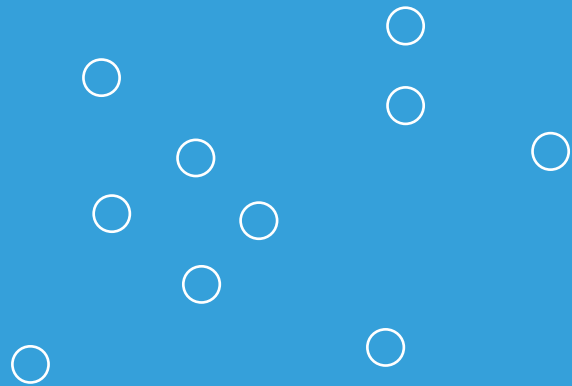# A Flowstream Approach for Sustainable Sanitation Systems

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EAWAG/ Sandec
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Sanitation Challenge- Wageningen

Eawag: Swiss Federal Institute of Aquatic Science and Technology

Conventional solutions and Innovations

- Improvements in sanitation coverage are not as expected

- Many technologies available, but decision-makers are often not aware

- Providing "toilets" to people does not necessarily solve the sanitation crisis.
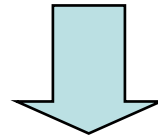
- NETSSAF coordination project for West Africa

- One task to better systematize all potentially feasible solutions

- Ensure that waste is managed from cradle to grave/reuse

What is a Sanitation System?

- The words '**Sanitation System**' are used frequently but without being clearly defined

- Without a overview of the flows **into** and **within** the system it is difficult to design something sustainable

    – e.g. the generation of **Faecal Sludge**

    – e.g. **transport** is often overlooked as a important step

- Propose a method of defining the parts of and method for visualizing and designing ,'cradle to grave' systems

A common language

- Except for a few standard terms (blackwater) here is no common language for describing the parts of a system

- By **defining** and **differentiating** between the parts of a system, a standard design method can be implemented using the following:

  - **Products**
  - **Processes**
  - **Technologies**
  - **Flowstream**
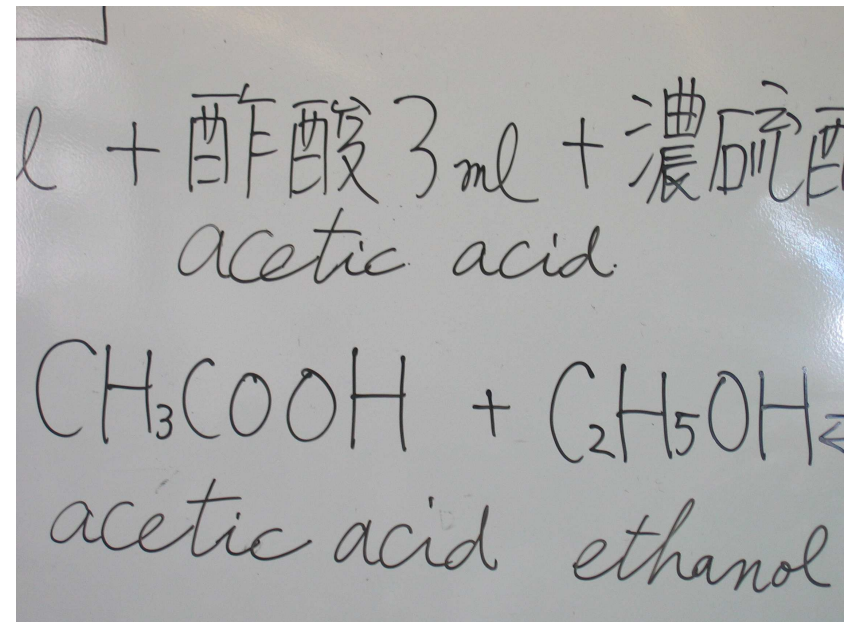
Products- the reason for the system

- Products are classically called '**wastes**' although **need not be wasted**

- Some products are generated at **intermediate steps**

- Products are all very different in their **composition, volume, reuse potential, pathogenicity,** etc., and therefore should be considered separately

- Technologies process different products differently;

'**round hole-square peg' approach**

Products (raw inputs & newly generated products)

Urine — Urine- undiluted urine that is not mixed with faeces or water

Faeces — Faeces- (semi-) solid excrement without any urine or water

Excreta — Excreta- mixture of urine and faeces without water

Greywater — Water used for the washing of food, clothes, dishes, people and things. It does not contain excreta but it still contains pathogens and organics

Blackwater — Blackwater- the mixture of urine, faeces and flushing water + anal cleansing water / dry cleansing material

Faecal sludge — Faecal Sludge- is the general term for the undigested, or partially digested slurry or solid that results from the storage or treatment of blackwater or excreta

Anal Cleansing Water — Anal Cleansing Water- the water used to wash oneself after urinating or defecating

Processes

- **Products move through Processes**

- Processes are ways of **grouping technologies**

- Technologies within the same Process, perform the same (general) **task, or process**

- Each technology performs the task, but in a **different way** and with a different degree of **efficiency**

- By classifying techologies by 'task' or into Processes, they can more easily be linked and organized

Processes- Groups of Technologies

| Process Title	Description
User Interface	Describes the way in which **users access and interact** with the sanitation system
On-site Collection, Storage and Treatment	Describes the technologies that can be used at the **household/compound level to collect, store and (partially) treat** different flowstreams
Transport	Describes the way in which **flowstreams are transferred** from the household to a centralized treatment/use facility
Treatment off site	Describes the technologies used to **reduce the pathogenicity** and/or **nutrient loads** of the flowstreams
Reuse	Describes the technologies and /or methods which **allow some benefit** to be derived from a flowstream
Disposal	Describes the technologies and/or methods which allow the flowstreams to be **returned to the environment** in a benign/non-detrimental way

Technologies- pieces of the puzzle

- Technologies are **product specific methods or tools used to collect, store, transform, move or dissiptate a product**

- A product will be processed by a series of technologies

- Names are not 'standardized'
    – will always be regional conventions
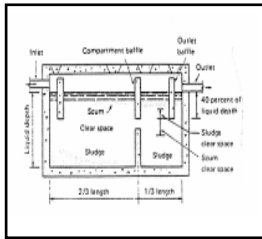   – the proposed list is not exhaustive
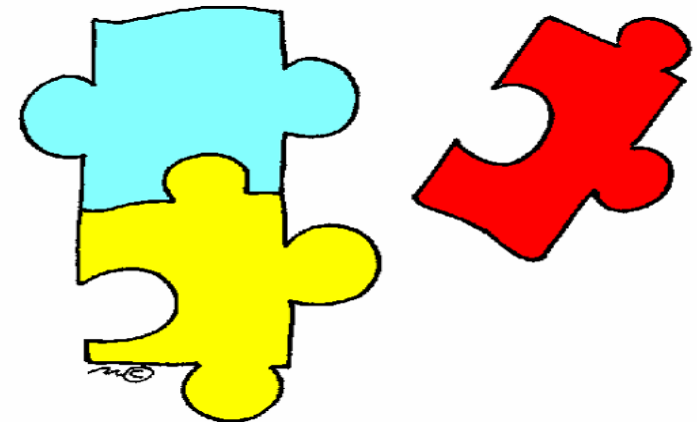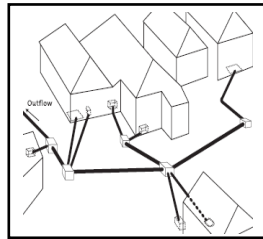
Technologies-Grouped by Process
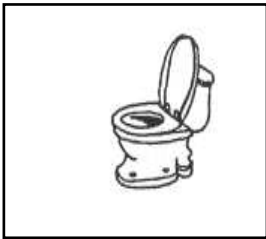
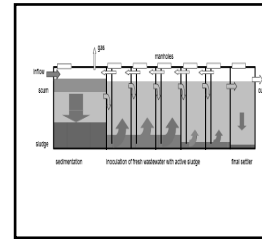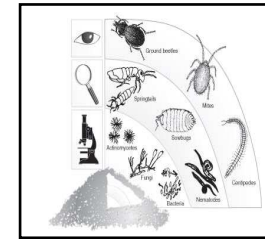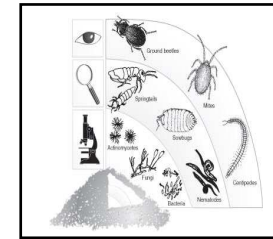| User Interface	Onsite Collection Storage & Treatment	Transport	Centralized Treatment	Reuse	Disposal
-Dry Toilet -Urine Diverting Dry Toilet -Urinal -Pour Flush Toilet -Flush Toilet	-Single Pit -VIP -Alternating Wet Double Pit -Double Dehydr. Vaults -Aquaprivy -Septic Tank -Composting Chamber	-Manual Emptying -Mechanical Emptying -Simplified Sewers -Small-Bore Sewer Conventional Gravity Sewer -Jerry can/tank	-Imhoff Tank -ABR -Anaerobic Filter -Trickling Filter -Waste Stabilization Ponds -Constructed Wetland -Co-composting	-Application of Urine -Application of Dehydrated Faeces -Compost -Irrigation with Wastewater -Aquaculture Ponds	-Soak Pit -Leach Field -Incineration -Land application -Surface Disposal

Flowstreams and Systems

Flowstreams are:

The SUM of the products that travel through the processes

+

The product-specific technologies through which the products travel

Systems are:

The SUM of the Flowstreams

Conceptualizing a Sanitation System

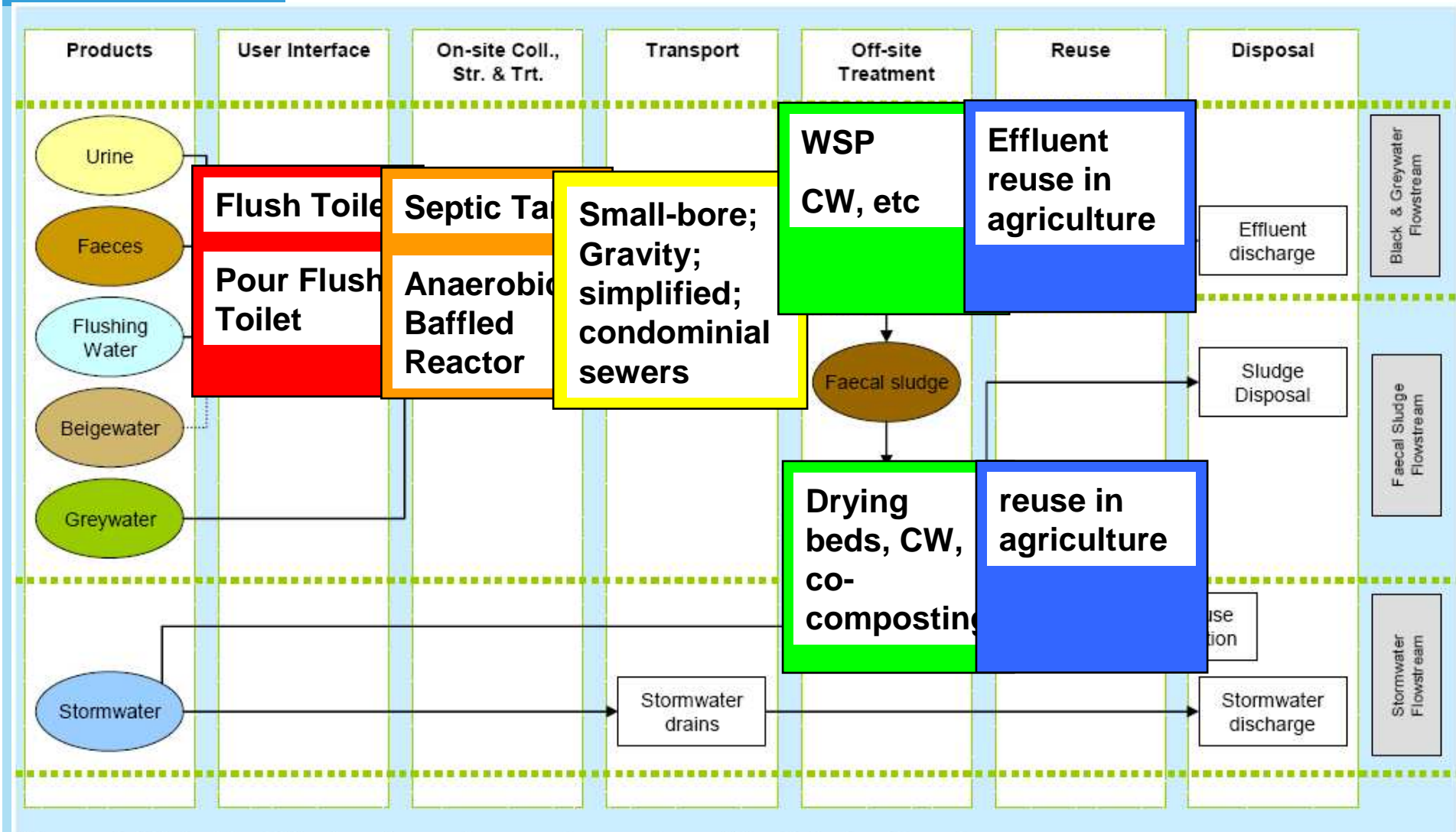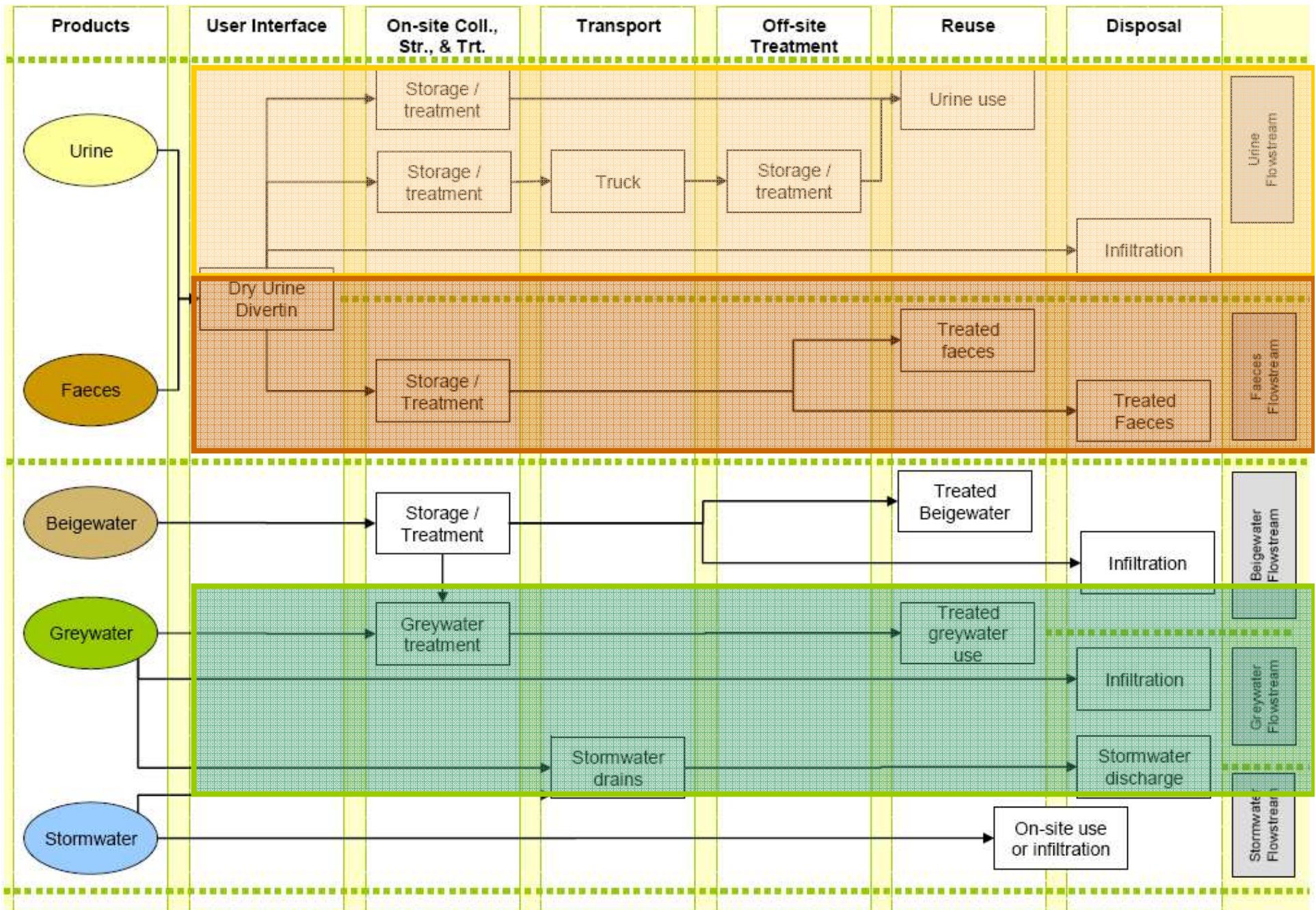| No.	System name	Flowstreams
1	Wet mixed blackwater and greywater system with offsite treatment	▪ blackwater mixed with greywater flowstream ▪ faecal sludge flowstream
2	Wet mixed blackwater and greywater system with onsite treatment	▪ blackwater mixed with greywater flowstream ▪ faecal sludge flowstream
3	Wet blackwater systems (blackwater separated from greywater)	▪ blackwater flowstream ▪ faecal sludge flowstream ▪ greywater flowstream
4	Wet urine-diversion system	▪ urine flowstream/ yellowwater ▪ brownwater mixed with greywater flowstream ▪ faecal sludge flowstream
5	Dry greywater-separate system	▪ excreta flowstream ▪ greywater flowstream
6	Dry urine- and greywater-diversion system	▪ urine flowstream ▪ faeces flowstream ▪ greywater flowstream
7	Dry all mixed systems	▪ excreta mixed with greywater flowstream

Figure 1. Wet mixed blackwater and greywater system with offsite treatment

The diagram contains the following columns: Products, User Interface, On-site Coll., Str. & Trt., Transport, Off-site Treatment, Reuse, Disposal.

Products: Urine, Faeces, Flushing Water, Beigewater, Greywater, Stormwater

User Interface: Flush Toilet; Pour Flush Toilet

On-site Coll., Str. & Trt.: Septic Tank; Anaerobic Baffled Reactor

Transport: Small-bore; Gravity; simplified; condominial sewers

Off-site Treatment: WSP CW, etc; Faecal sludge; Drying beds, CW, co-composting

Reuse: Effluent reuse in agriculture; reuse in agriculture

Disposal: Effluent discharge; Sludge Disposal; Stormwater discharge

Flowstreams: Black & Greywater Flowstream; Faecal Sludge Flowstream; Stormwater Flowstream

Stormwater drains

Figure 2: Overview of sanitation system options.

In Conclusion

- By building a system up using pre-defined…
    - ➤ **PRODUCTS** which travel through
    - ➤ **PROCESSES** which contain
    - ➤ **TECHNOLOGIES** which can be selected according to the context and then grouped into
    - ➤ **FLOWSTREAMS** which can be combined into
    - ➤ **SYSTEMS**

- A more thorough assessment, and plan of the sanitation system can be achieve, thus ensuring increased efficiency and reduced redundancy.

- Next steps include stakeholder workshops and dissemination among target users; hard and interactive digital products

- Field testing, refinement and revision

Thank-you