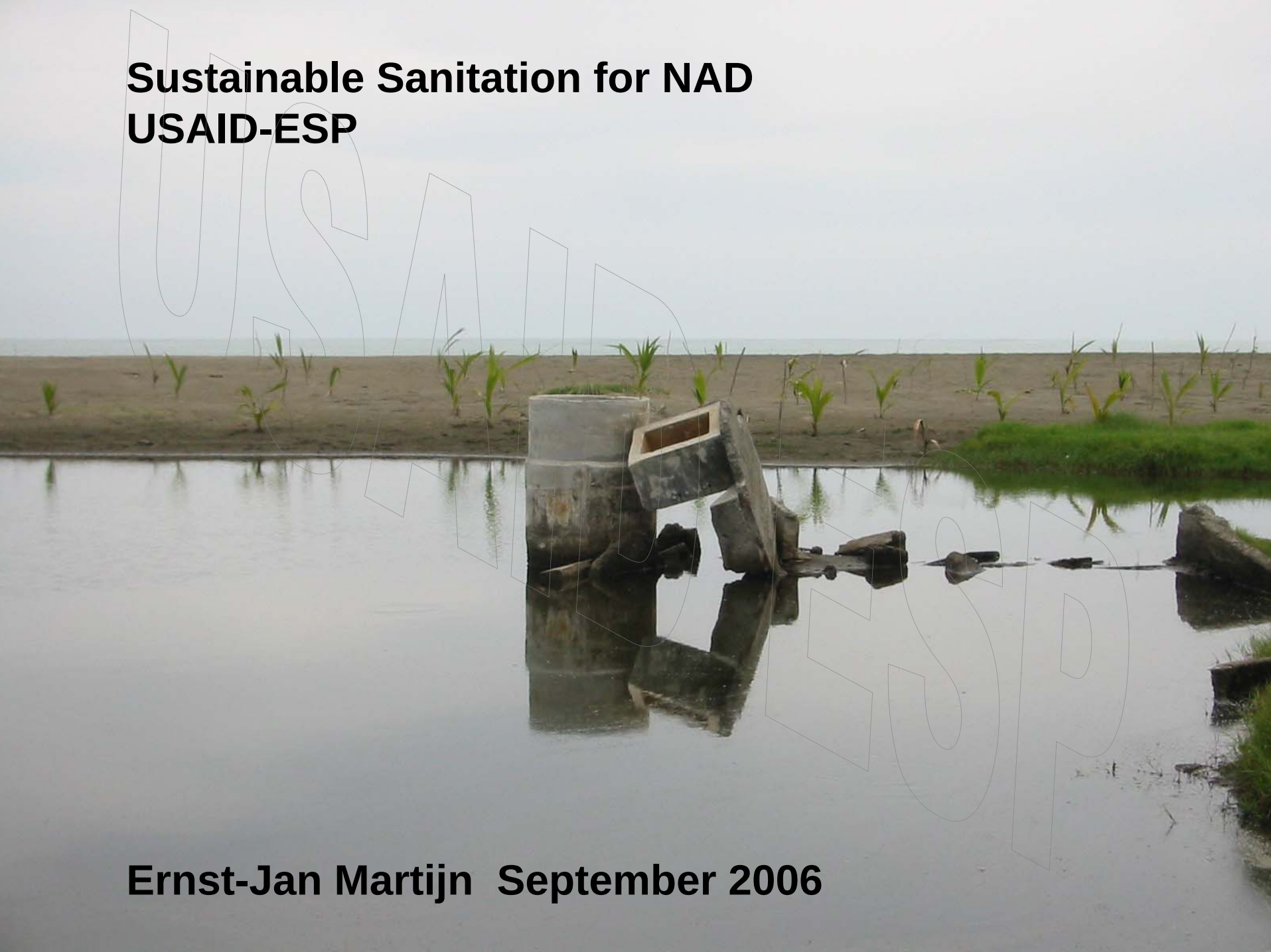
Sustainable Sanitation for NAD
USAID-ESP



Ernst-Jan Martijn September 2006

Environmental Services Program

December 2004 till September 2009

'Ridges to Reefs' approach

linking water resources management with improved health

Part of USAID Indonesia's Basic Human Services

7 High Priority Integrated Provinces

NAD, N-, W-Sumatra, E-, Central-, W-Java & Banten

4 Special Imperative Areas

Balikpapan, Manado, Manokwari and Jayapura

5 Workshops Sustainable Sanitation

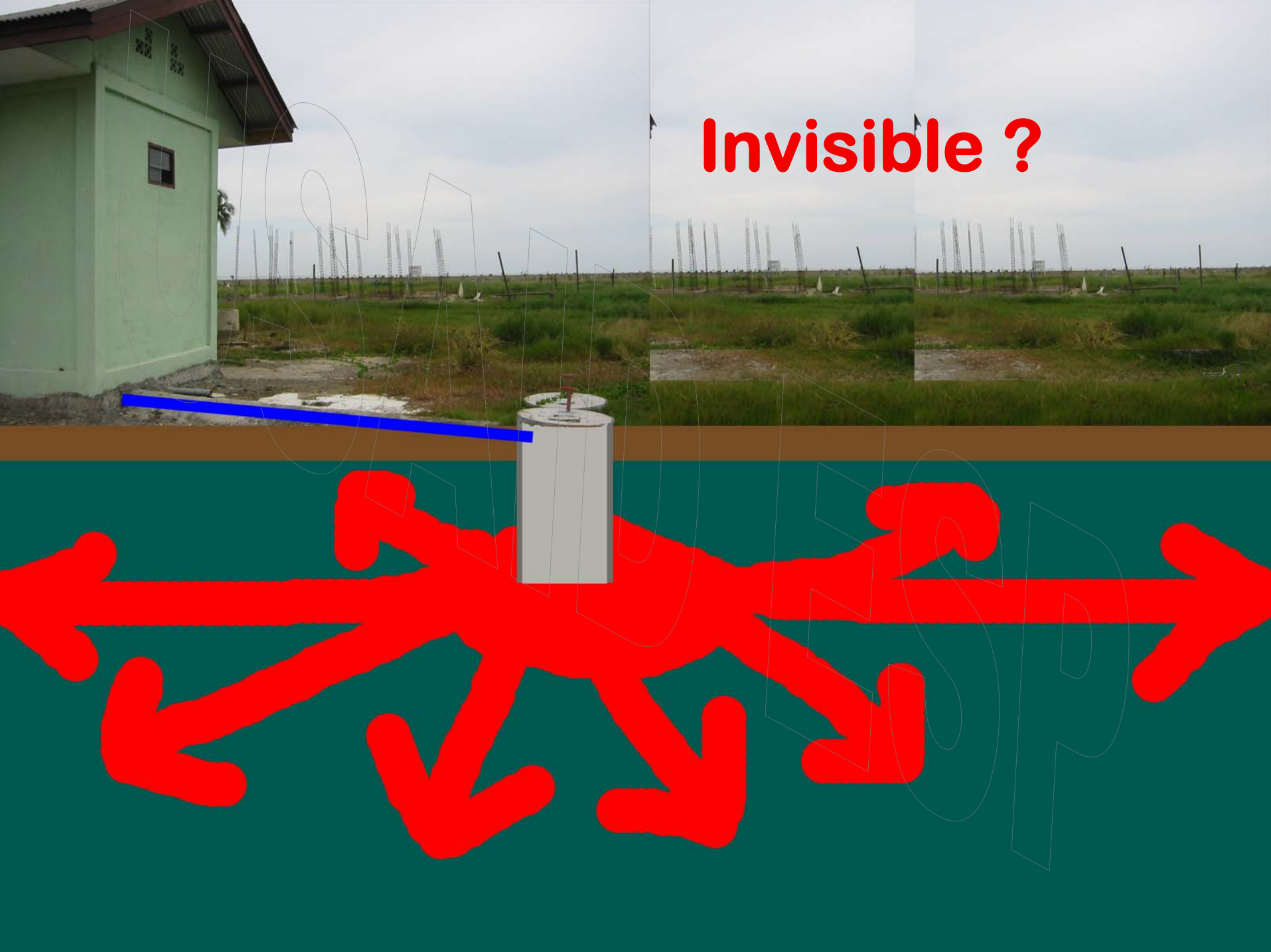
May June July 2006 – Banda Aceh & Calang

30+ orgs & 200+ watsan specialists

Handbook

Next workshop in Meulaboh around mid-November 2006


What is the problem?


Invisible ?

The 'invisible' problems with soak-pits in high groundwater

Direct contamination/pollution of groundwater

Health Risk – pathogens and nitrates in shallow wells

Even if the community has piped water/deep wells:

Indirect Downstream Impacts

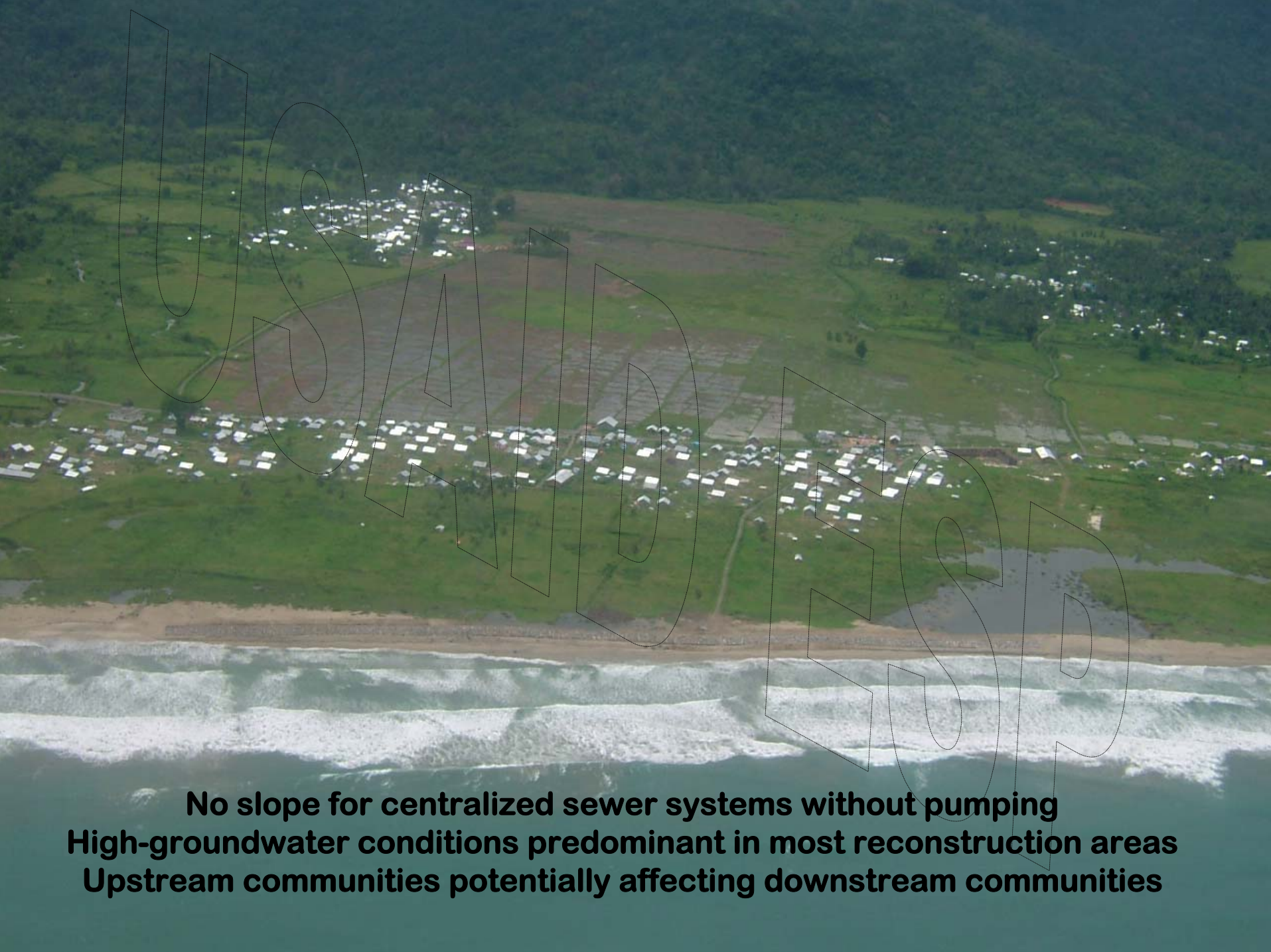
Public Health, Environment, Livelihoods and WRM

Downstream communities rely on shallow wells
Downstream communities rely on good quality water for aquaculture
Polluted groundwater affects surface water, which affects PDAM's
Mangroves and coral reefs are affected by nutrient pollution

Polution Example

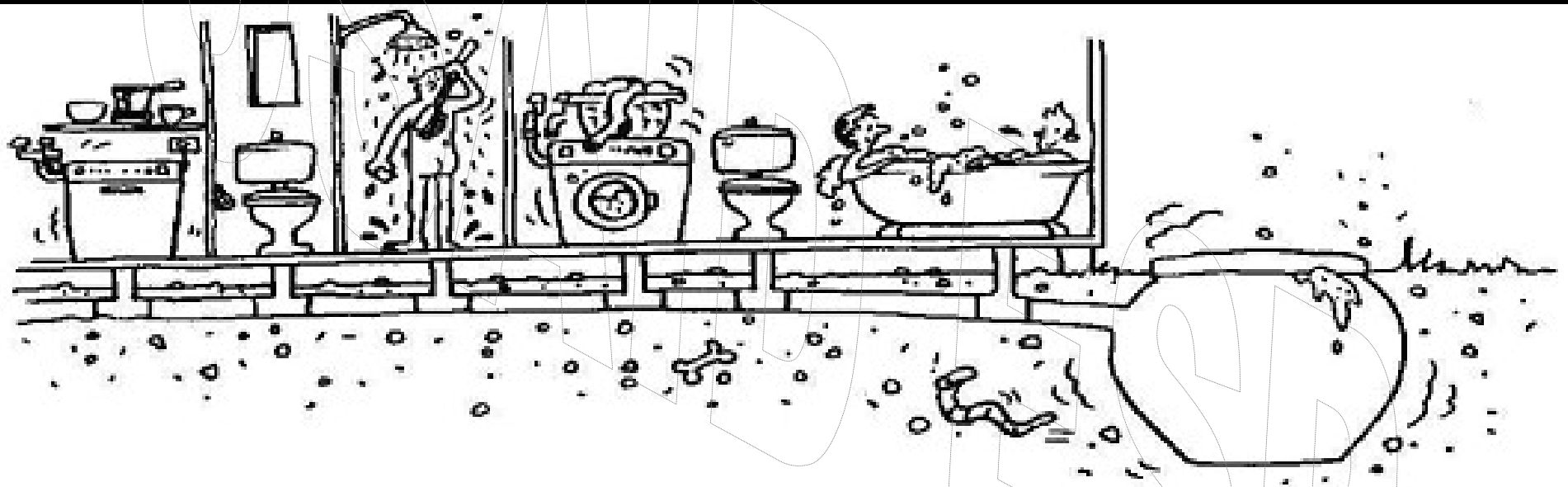
soak-pit next to fishpond

**Fishponds are used in some countries to treat wastewater, but these are managed whereas above is not.*



No slope for centralized sewer systems without pumping
High-groundwater conditions predominant in most reconstruction areas
Upstream communities potentially affecting downstream communities

Solution
Waterproof Septic Tank



Building Codes

PU Building Code matrix of NAD Province (2005)

Installation Difficulties

High Groundwater

Poor Quality Material 'Kick Test'


But in Meulaboh there are good quality cincin's …


...which can be prefabricated with a bottom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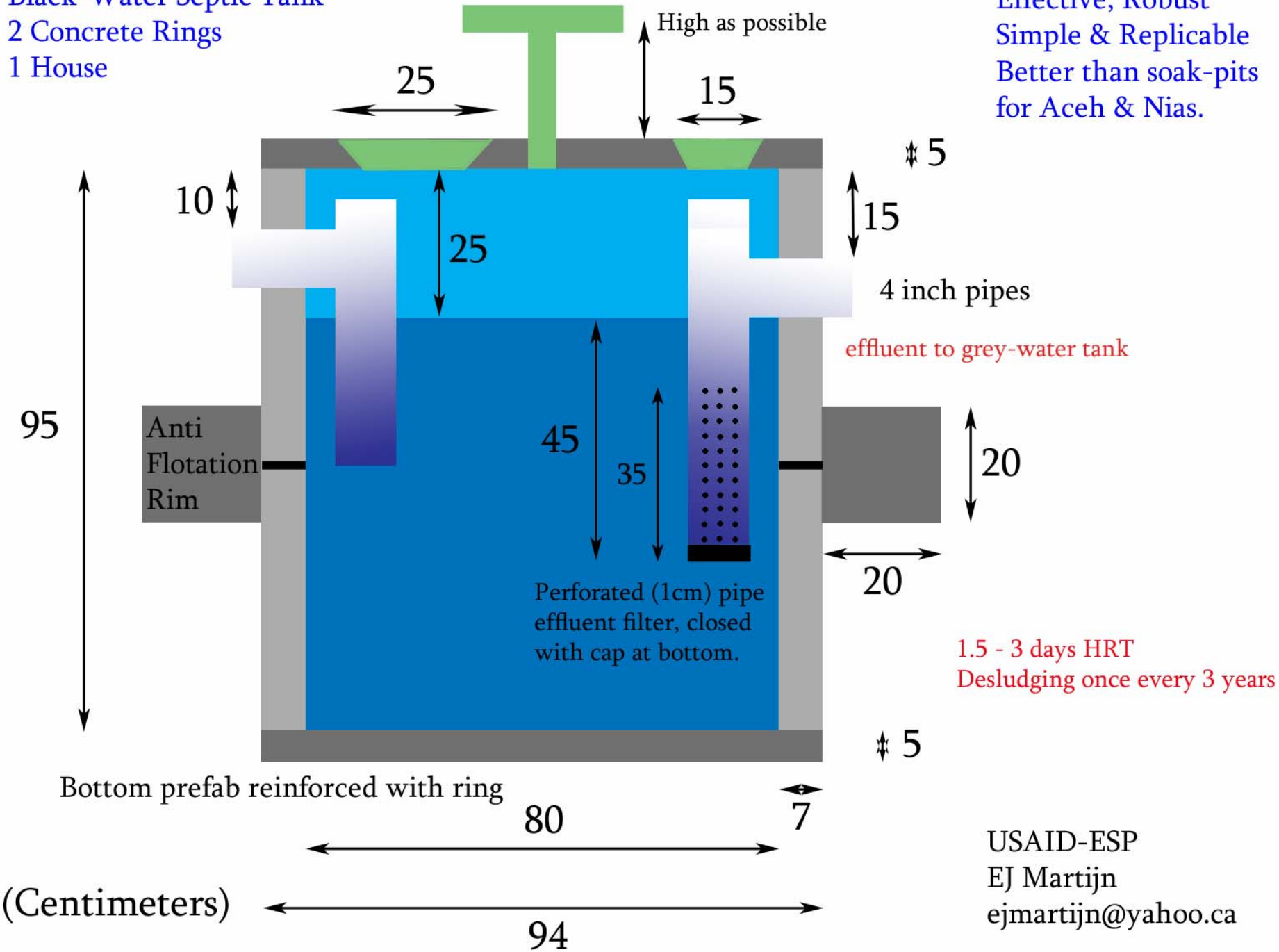
Black-Water Septic Tank
2 Concrete Rings
1 House

Effective, Robust
Simple & Replicable
Better than soak-pits
for Aceh & Nias.



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Building Codes

PU Building Code matrix of NAD Province (2005)

'All' wastewater should be treated

This includes grey-water!

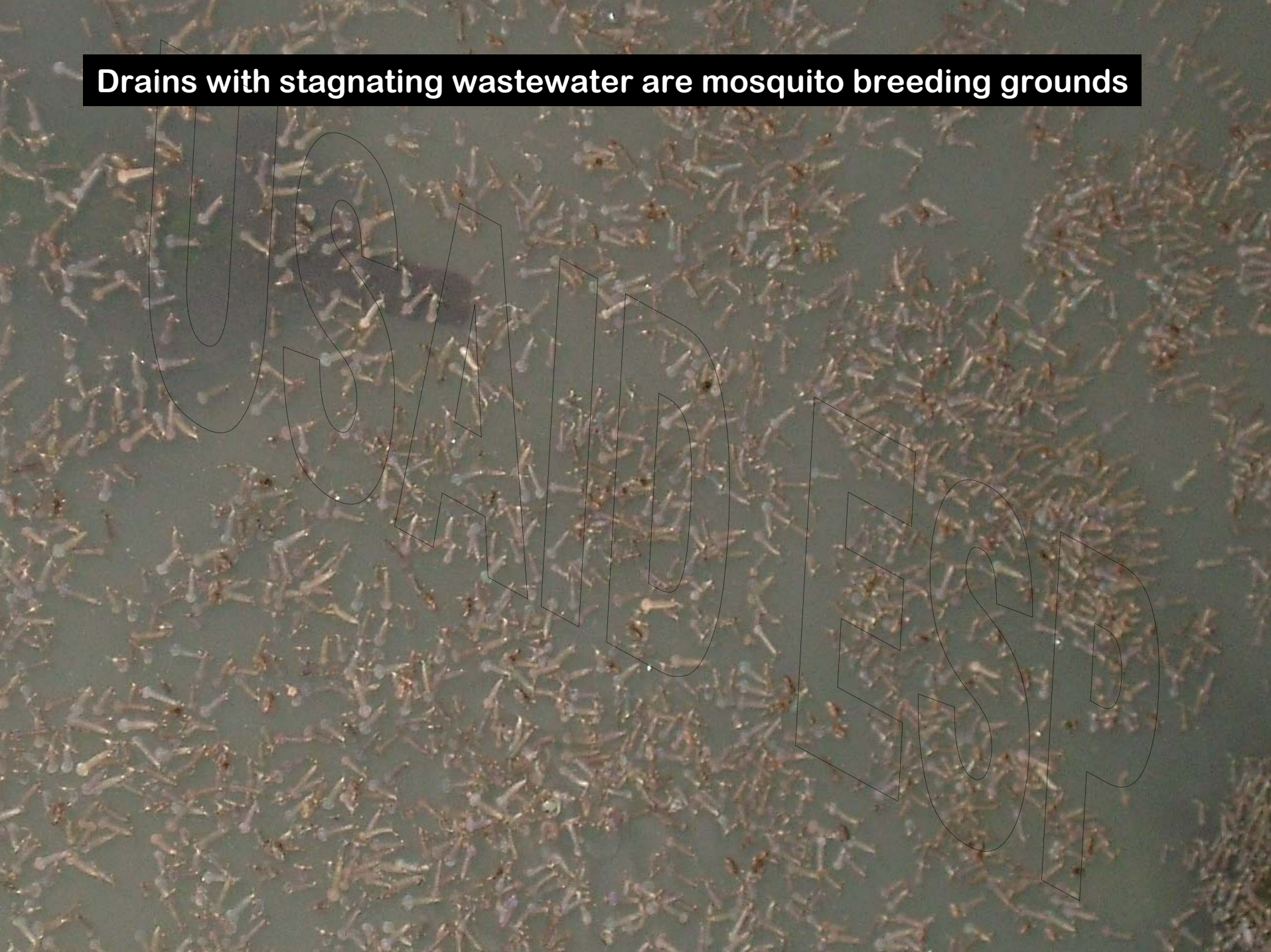
All septic tanks should be waterproof

Outflow should go to a leach-field

or, in high water tables (< 1m),

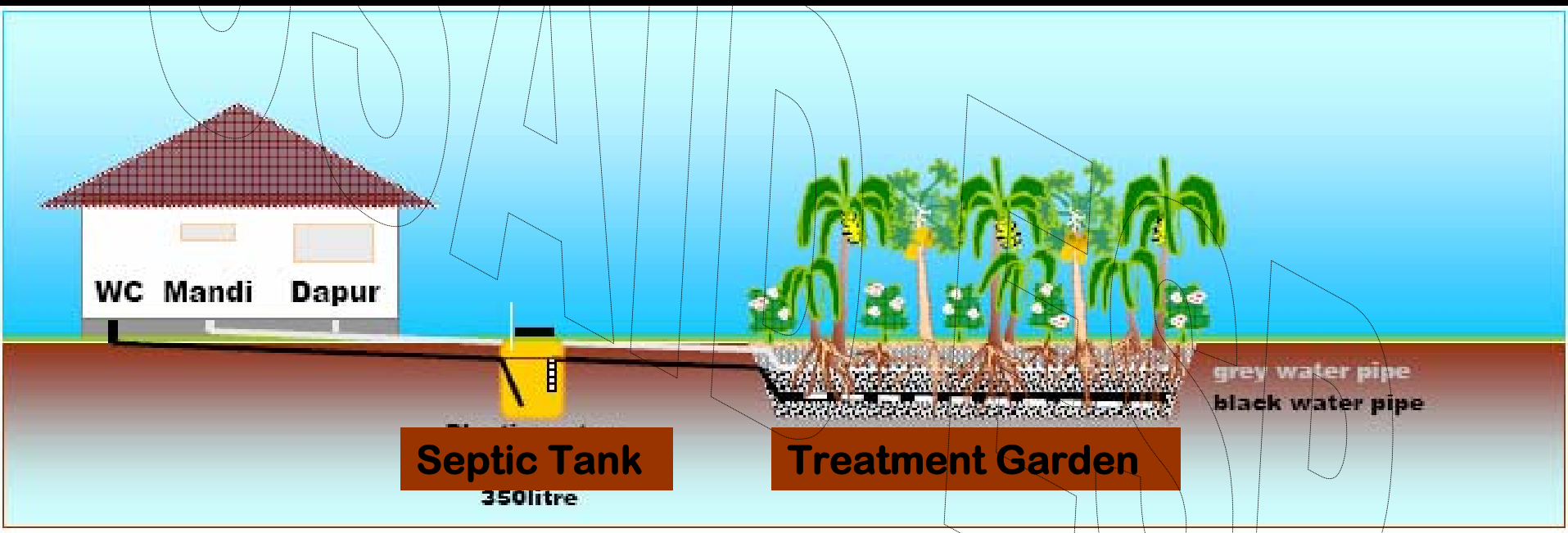
should be 'made to flow horizontal'

Drains are not designed to convey grey-water, but peak storm floods


Drains with stagnating wastewater are mosquito breeding grounds

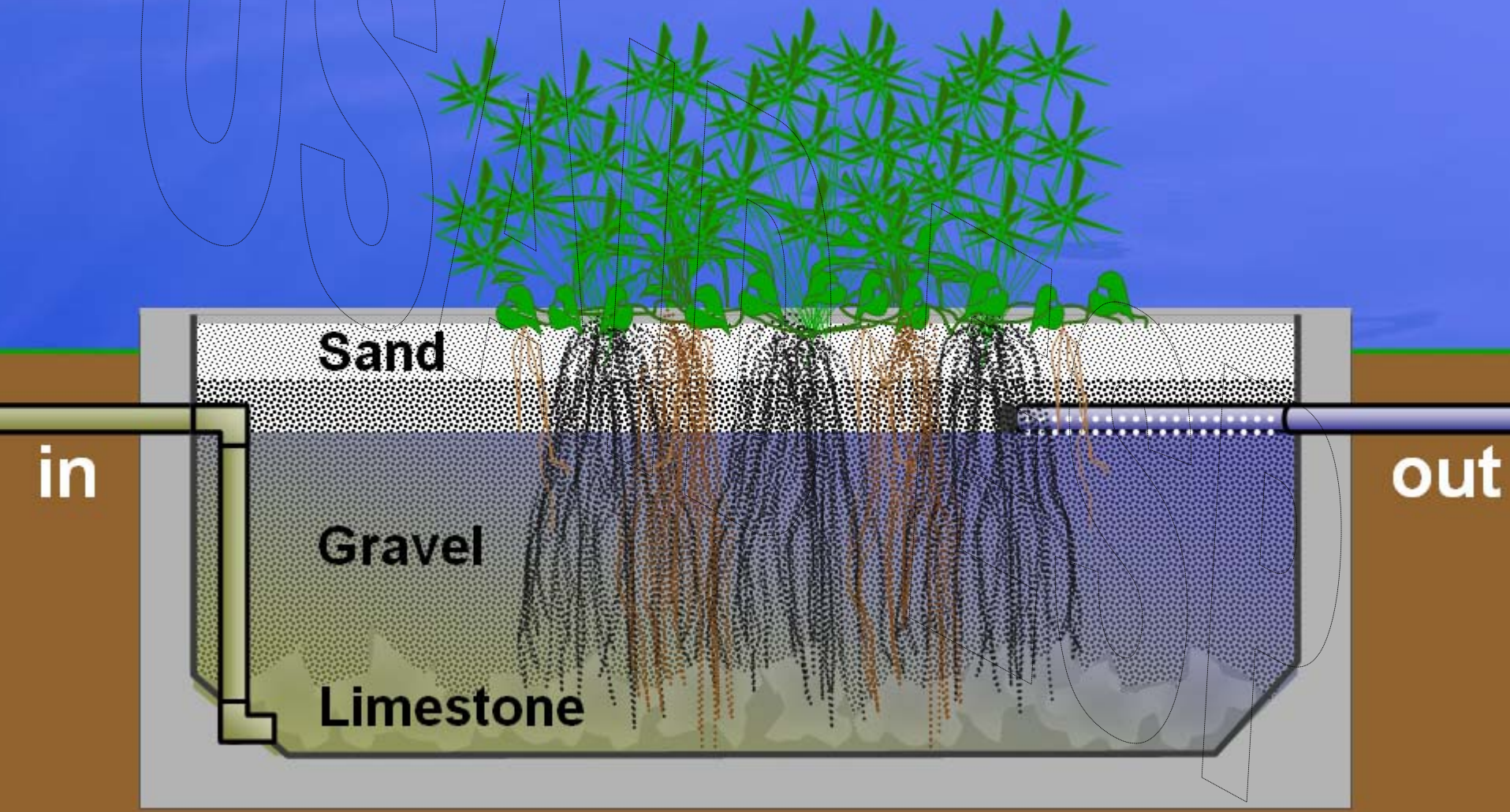
Solution for ‘horizontal flow’ of effluent

Waterproof Treatment Garden



Drawing by Norm Van’t Hoff 2006

Constructed Wetlands



Drawing by Norm Van't Hoff 2006

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2 Pilot Systems subsurface flow wetlands

Lhok Nga

Lam Kruet & Mon Ikeun

ESP Sustainable Sanitation Activities

A) **ESP Pilot Sanitation Systems**

B) **Liaison with aid agencies**

> sharing knowledge, raising important issues

> technical assistance

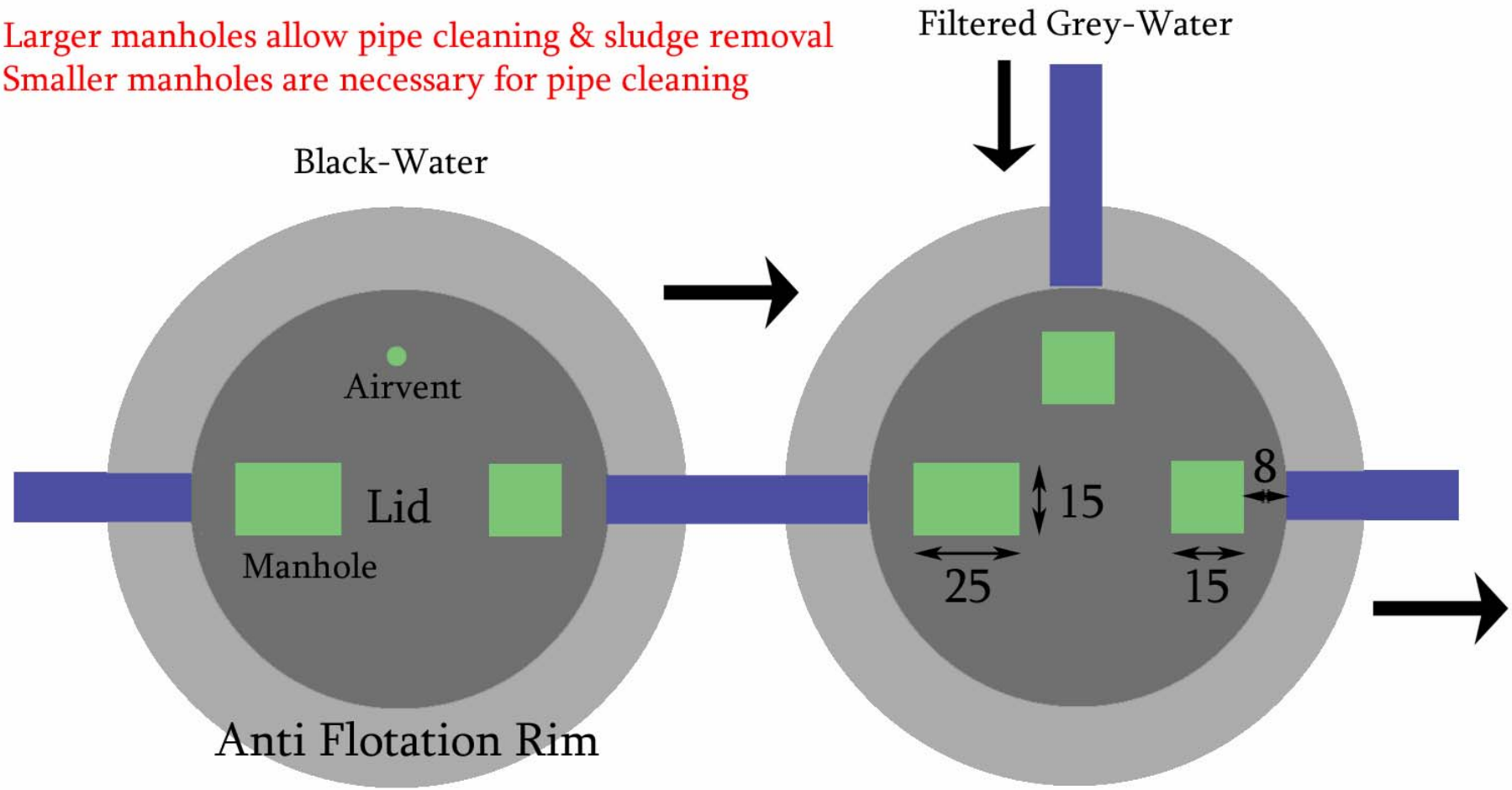
> community socialization assistance

C) **Monitoring & Evaluation** of san systems

D) **Workshops & Training**

Black- & Grey-Water Septic Tanks Top View

Larger manholes allow pipe cleaning & sludge removal
Smaller manholes are necessary for pipe cleaning



(Centimeters)

See other drawings for more details

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DETAILS - Anti Flotation Rim for Concrete Ring Septic Tanks

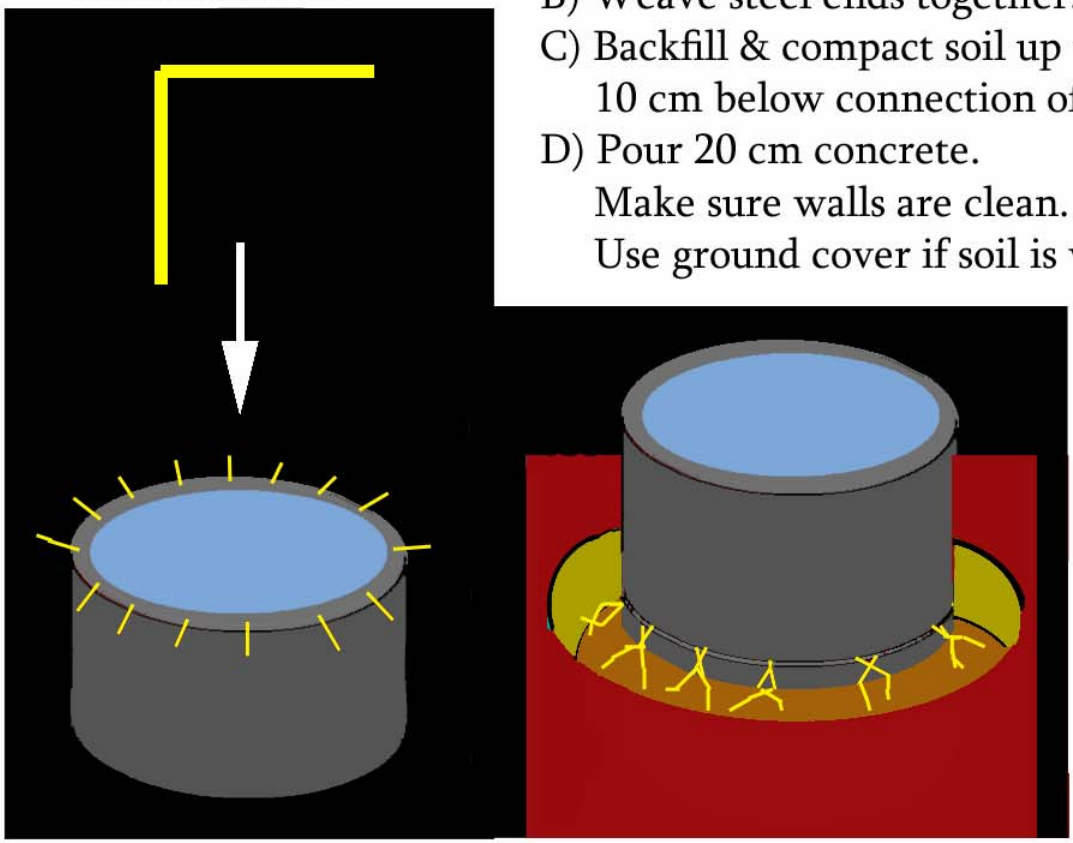
Using materials and skills that are locally available or obtainable in Aceh & Nias.

Step 1 (off-site)

Steel hooks (6mm)
added in rim
when cincin is made
1) 20cm + 20cm, or,
2) extension of bottom reinforcement

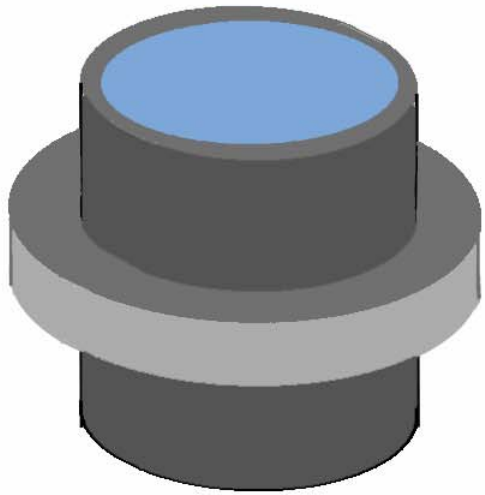
Step 2 (on-site)

A) Stack rings, both with steel, on top of each other with cement inbetween.
B) Weave steel ends together.
C) Backfill & compact soil up to 10 cm below connection of rings.
D) Pour 20 cm concrete. Make sure walls are clean. Use ground cover if soil is wet.



Result

Anti Flotation Rim
Waterproof Connection
& Rings Secured.



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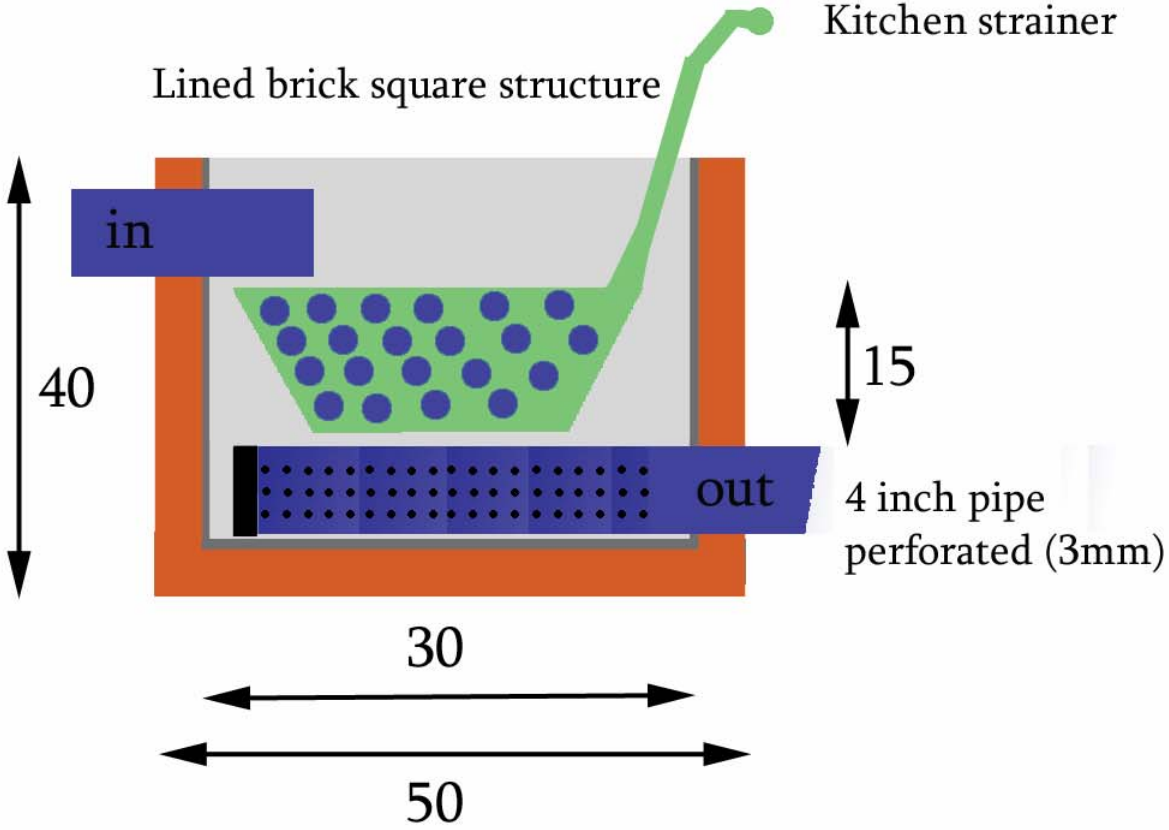
Grey-Water Filter
Pre-Septic Tank
1 House

Effective, Robust
Simple & Replicable
Reduces clogging and
sludge accumulation
in downstream systems.



(Centimeters)

Requires integration with solid waste management and community participation to keep clean.

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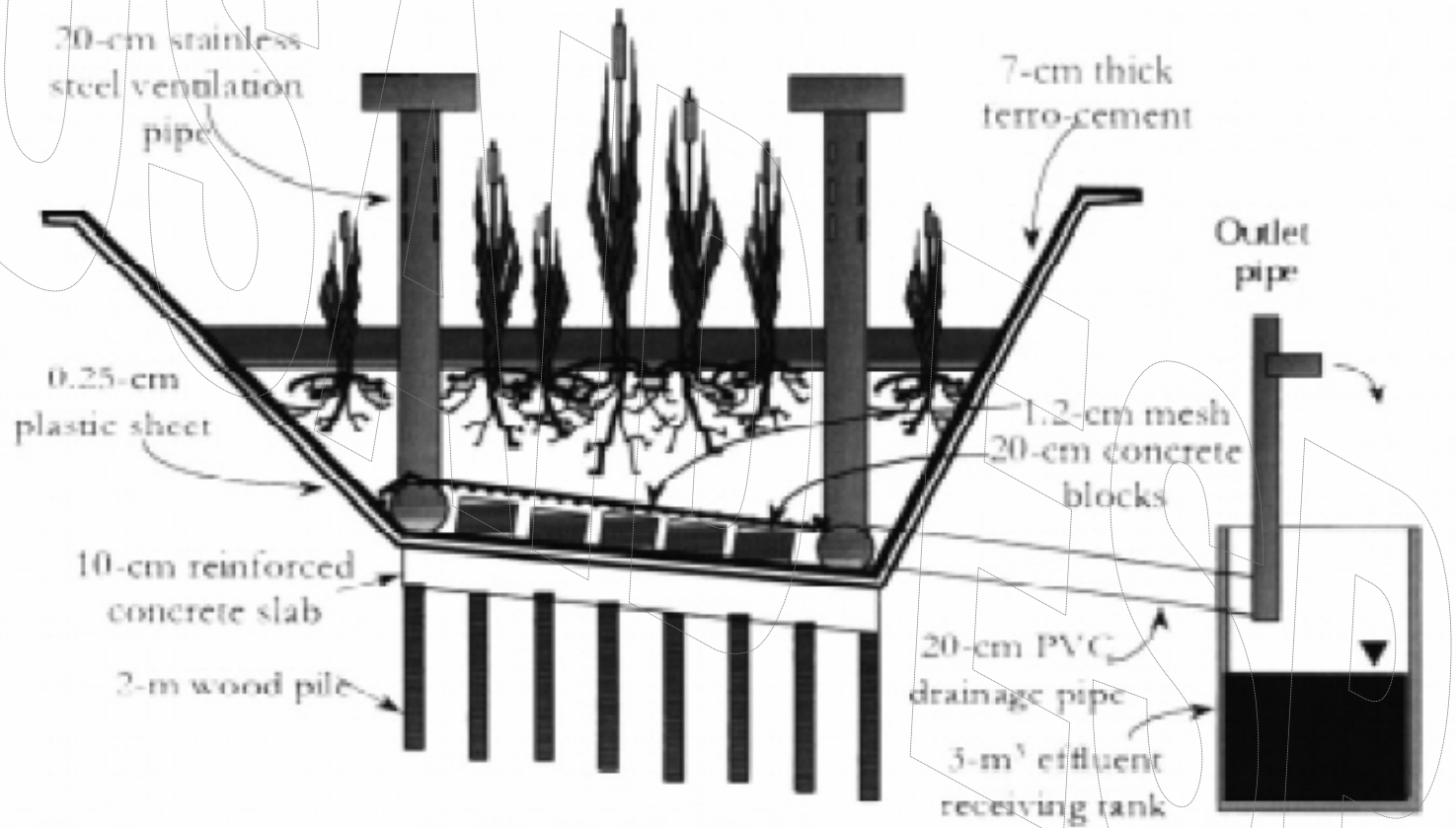
Figure 10.1 Reed Bed Design for Faecal Sludge Dewatering: SANDEC

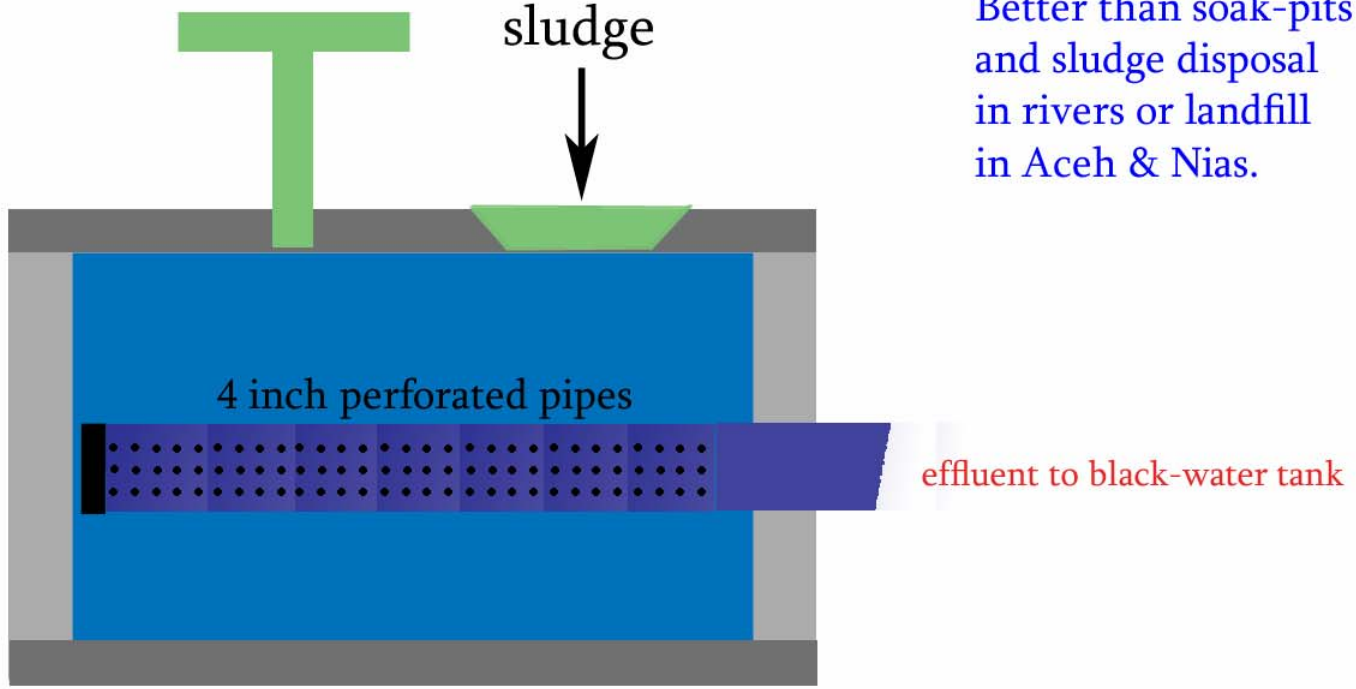


Source: Heinss and Koottatep, 1998

Concept for On-Site Sludge Drying
1 Concrete Ring
1 House

Effective, Robust
Simple & Replicable
Better than soak-pits
and sludge disposal
in rivers or landfill
in Aceh & Nias.

*Best design configurations still to be investigated



Bottom prefab reinforced with ring

Sludge can be pumped in from septic tanks using low-cost, low-tech pumps
(such as diaphragm pumps used on boats; can be mounted on a 'becak').
No transport necessary & dried domestic sludge is an excellent soil conditioner.

A concept like this requires full community support.
Sludge pumping and dried sludge collection for reuse
in farming/gardening can be a small business enterprise.

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NITROGEN

Figure 2. Nitrogen (g) produced in domestic wastewater per person per day

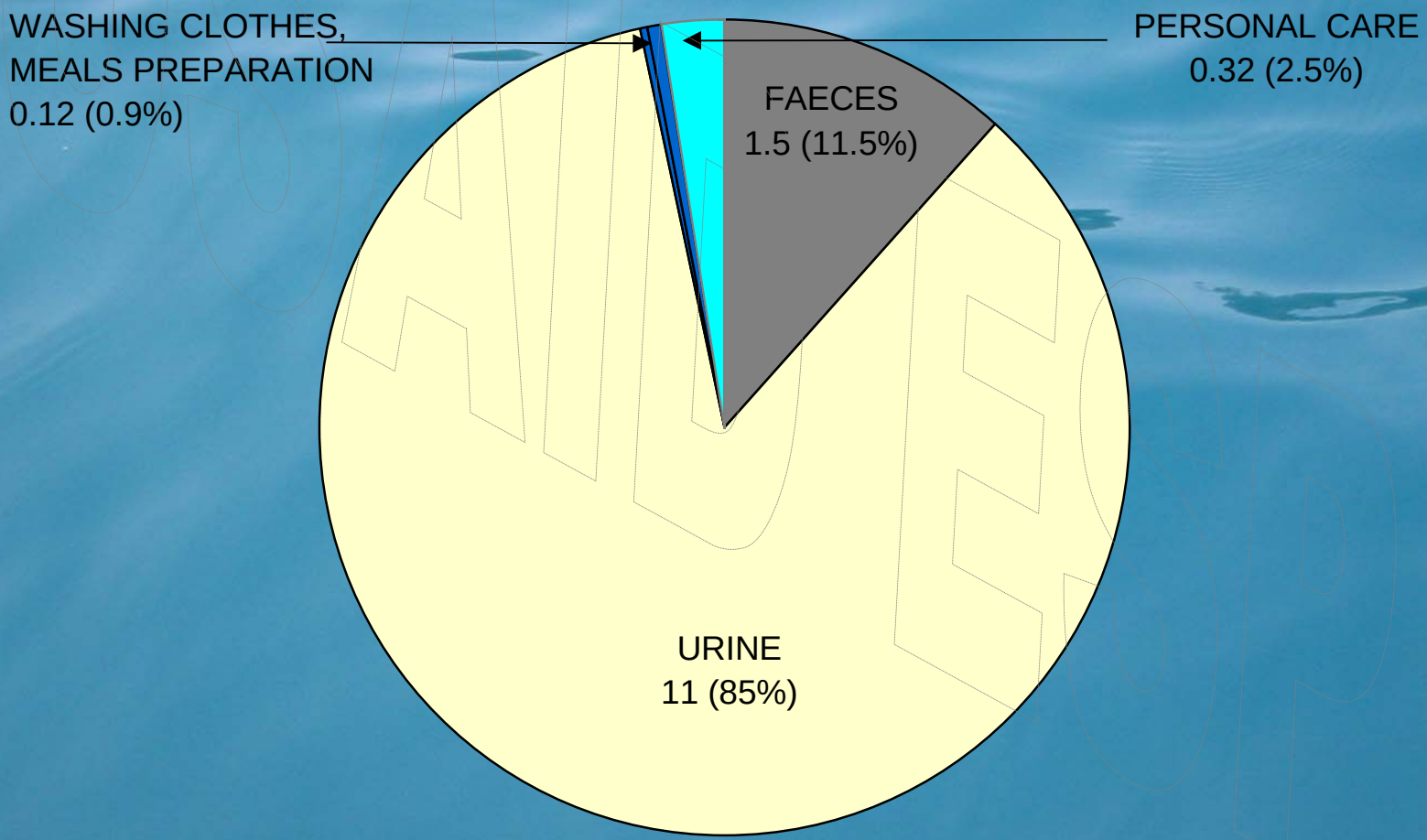


Table 2.1 Nutrients in Human Waste Compared to Nutrients in Commercial Chemical Fertiliser (Mid 1990's)

Country	Nutrient Equivalent in Commercial Fertiliser Applied[1] (percent)
Kenya	136
Tunisia	25
Indonesia	49
Zimbabwe	38
Colombia	31
Mexico	31
South Africa	29
Egypt	28
India	26

[1] Assumes loss of 50% of nitrogen content to volatilisation.

Source: Worldwatch Institute (Gardner, 1998)[1].

Table 1. Comparison of Typical Wastewater in Collection Systems, Expected Residential Wastewater, and Expected Septic Tank Effluent

Water Quality Parameter	Concentrations in Untreated Domestic Wastewater (mg/L), based on 454 L (120 gal)/capita·day	Concentrations in Untreated Residential Wastewater (mg/L), based on 189 L (50 gal)/capita·day	Septic System Effluent, Range and (Typical) Concentrations mg/L), based on 189 L (50 gal)/capita·day
Biochemical Oxygen Demand (BOD)	110-400 (250)	450	150-250 (180)
Chemical Oxygen /Demand (COD)	250-1,000 (500)	1,050	250-500 (345)
Total Suspended Solids (TSS)	100-350 (210)	503	40-140 (80)
Nitrogen (total as N)	20-85 (35)	na[b]	na
Total Kjeldahl Nitrogen as N	na	70	50-90 (68)
Organic Nitrogen as N	8-45 (13)	29	20-40 (28)
Ammonia (NH_3)	12-50 (22)	41	30-50 (40)
Total Phosphorus (P)	4-15 (7)	17	12-20 (16)
Oil and Grease	50-150 (90)	164	20-50 (25)

a. Data compiled from Crites and Tchobanoglous, 1998. Effluent concentrations do not include treatment by the soil.
b. na = not available

Why a grey-water (check-)filter is recommended

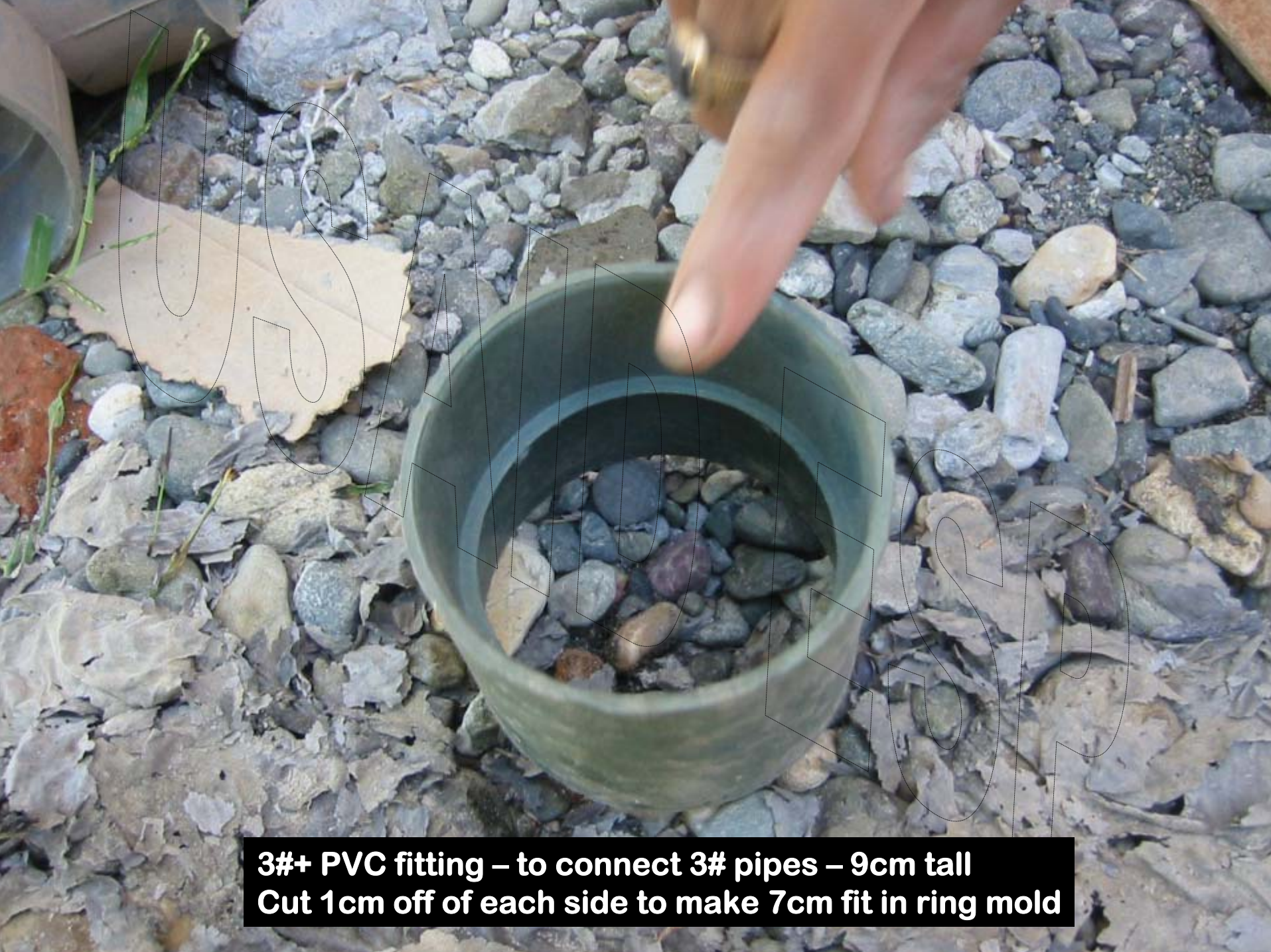
Typical Aceh situation– implementation with groundwater @ 45cm

Reinforced bottom for concrete ring – rebar extends 70cm up

Hooks will be bent sideways to create rebar for AFR (see ESP design)


USAID ESP


3#+ PVC fitting – allows inlet/outlet 3# pipes ‘plug n’ play’
Banana stem is inserted to keep cement out in the mold


3#+ PVC fitting – to connect 3# pipes – 9cm tall
Cut 1cm off of each side to make 7cm fit in ring mold

Prefabricated inlet / outlet holes for the upper ring

Photo: EJ Martijn - Riga, Calang – MEDIAR Sanitation 2006


Trumping 3# pipes to create 3# connection piece is difficult
Using fire or hot water – pipe shrinks back to original size and cracks

Idea of what a wastewater garden could look like
(for one house – it would be about half the size of this flower bed)
Using natural wetland plants would be better for the treatment
E.g. bulrush or cattails
But flowers look nicer and papaya is usefull


16 June 2006
USAID-ESP
E.J.Martijn
Concept for Sanitation
Budha Tzu Chi
Meulaboh
350 liters
Septic Tank
(black-water)
Brick/Concrete
Grey-water
Filter
Waterproof Brick/Concrete
GardenFilter
(septic tank effluent + filtered grey-water)
Buried 3# PVC pipe
to big drain in front
of the house