

**TRAINING FOR IMPROVED PRACTICE:  
Public Health and Nutrition in Emergencies**

**Water and Environmental  
Sanitation**

**Franklin Broadhurst**

**International Rescue Committee**

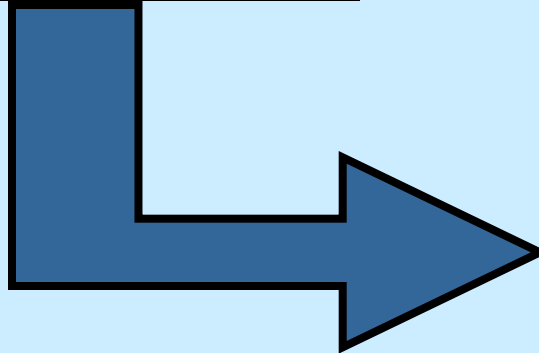
UNICEF Core Corporate Commitments Training in Collaboration With:

**Feinstein International  
Famine Center,  
Tufts University**

**Mailman School of Public  
Health,  
Columbia University**

**International Emergency and  
Refugee Health Branch,  
Centers for Disease Control**

*... our target*



# Key components of a Water and Environmental Sanitation Program

## **WES includes:**

**Water supply**

Disposal of the dead

**Latrines**

**Drainage and waste  
water disposal**

Site selection and  
planning

Environmental hazard  
protection; fires, wind,  
flooding, etc.

Shelter

**Garbage disposal**

Dust control & road  
construction

Vector control

**Hygiene Promotion**



## Participants

- *NGO staff and/or international organization*
- *Local National Staff*
- *Local Government Agencies*
- *Displaced government agencies and/or groups*
- *Displaced /affected communities*
- *Host communities*

**\* Level of Community Participation**

# Agenda

- *Overview and relevance (WES CCCs)*
- *Rapid Assessments (Exercise)*
- *Hygiene Promotion*
- *Sanitation (Case Study)*
- *Water Supply & Treatment*
- *East Timor (Case Study)*



# Objectives:

- provide an overview of WES “good practices”
- present and discuss commonly proposed standards for WES activities
- present different approaches to implementing WES programs in emergencies

## ***Core Abilities***

- **Assess and prioritize critical WES activities**
- **Understand the benefits of hygiene promotion and community participation**
- **Describe advantages and disadvantages of various sanitation interventions**
- **Describe advantages and disadvantages of various water supply and treatment options**

## *Key Messages*

- Diarrhea is one of the top killers
- Sanitation is of prime importance
- Lots of water of fair quality is more important than a small quantity of very pure water
- Hygiene Promotion - the missing link
- Prioritize today and plan for tomorrow

# Why so crucial ...

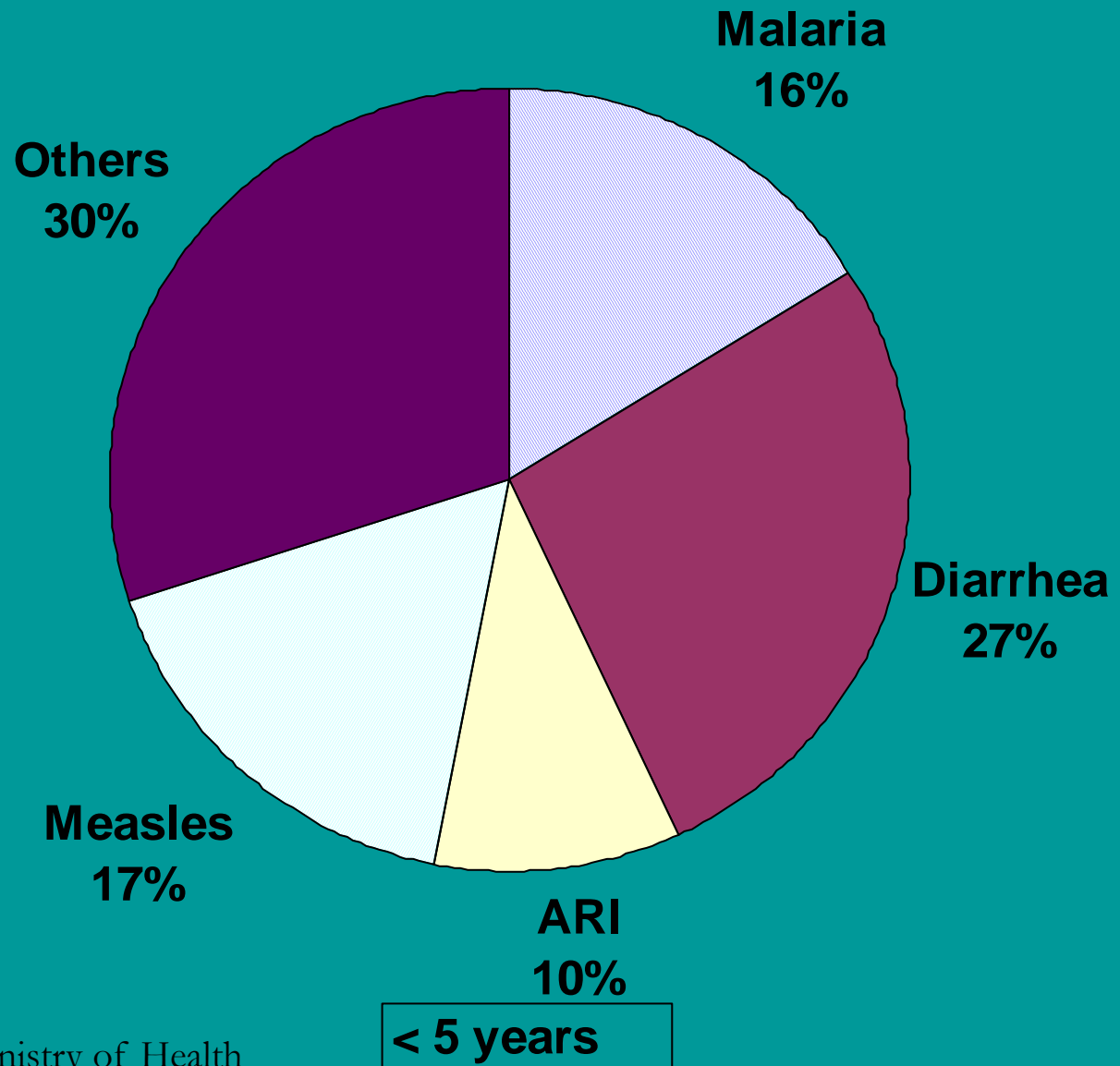
**Communicable diseases & epidemics**

**Major causes of morbidity & mortality**

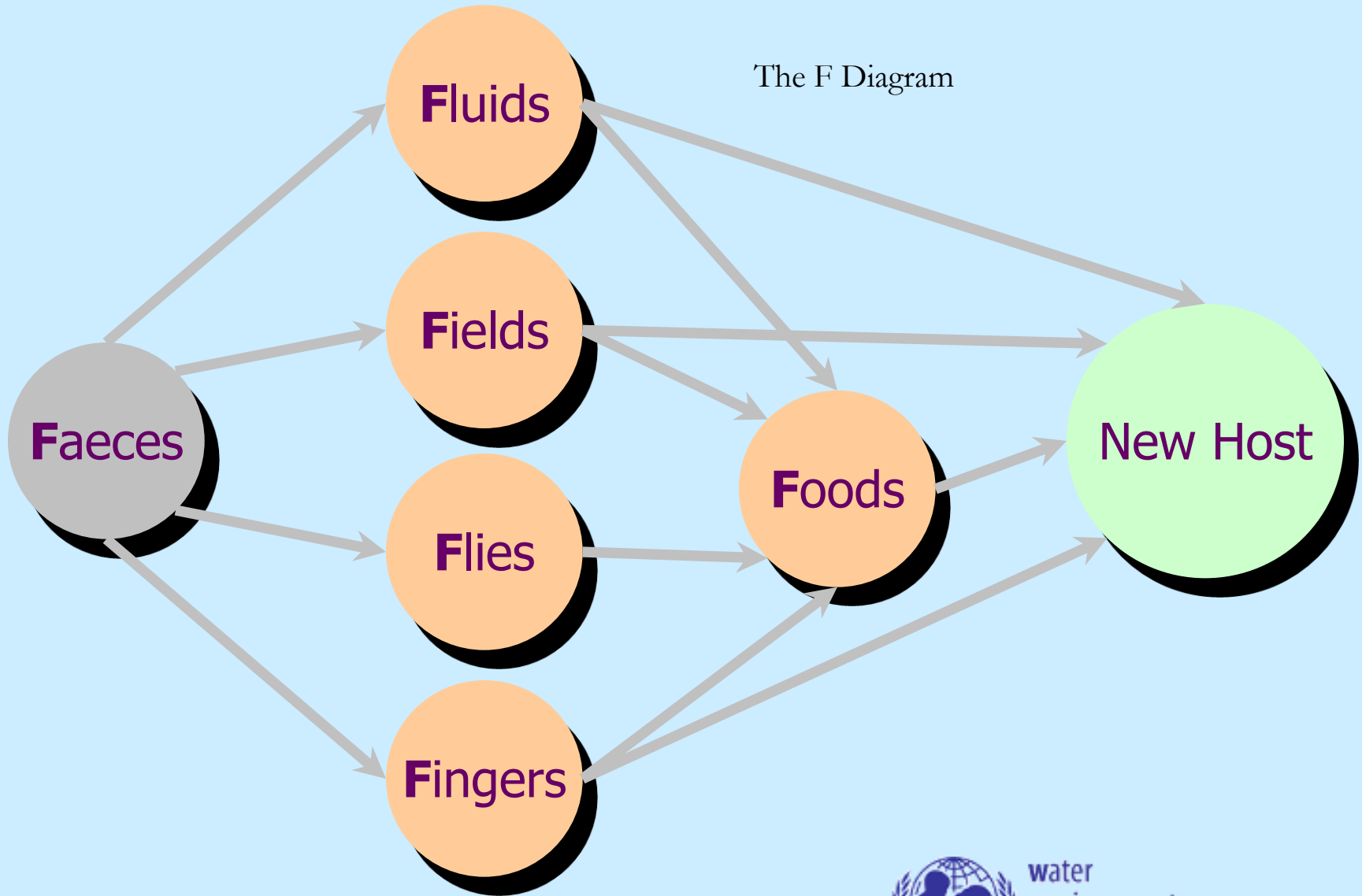
**In 1994 Goma - 85% of all the deaths  
were associated with diarrheal diseases**



# Proportional mortality among Mozambican refugees in Malawi 1987-1989

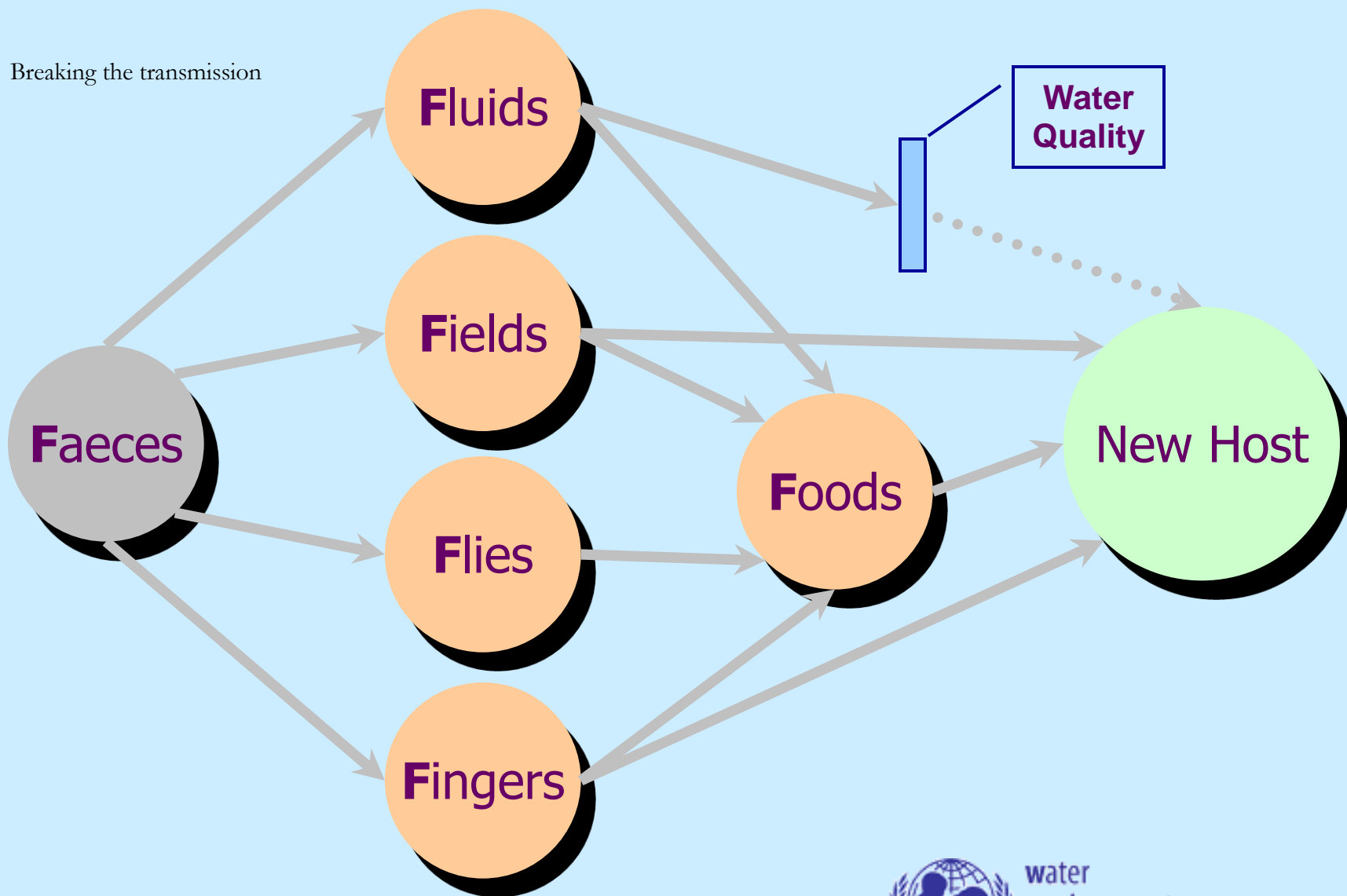


The F Diagram

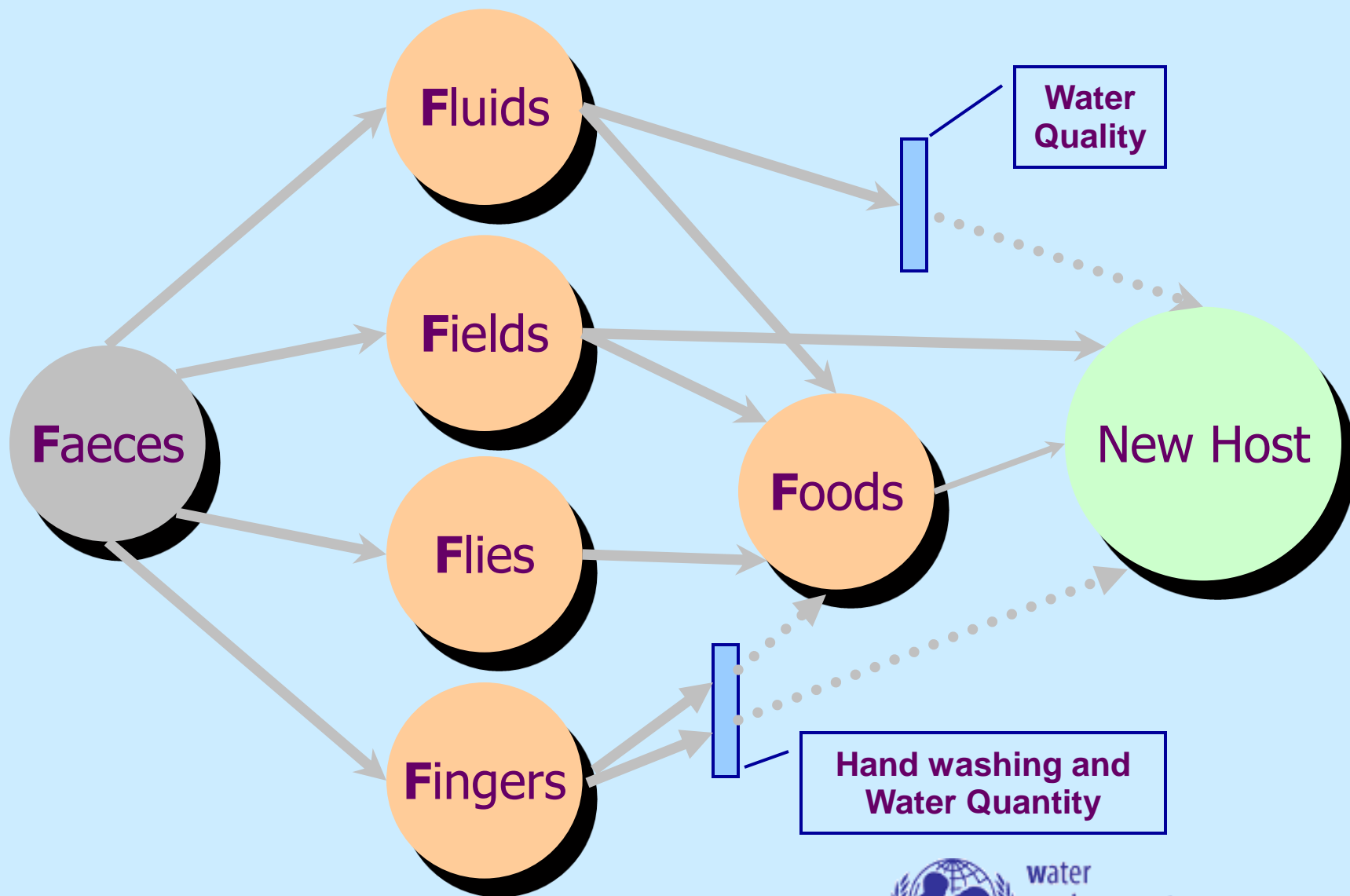


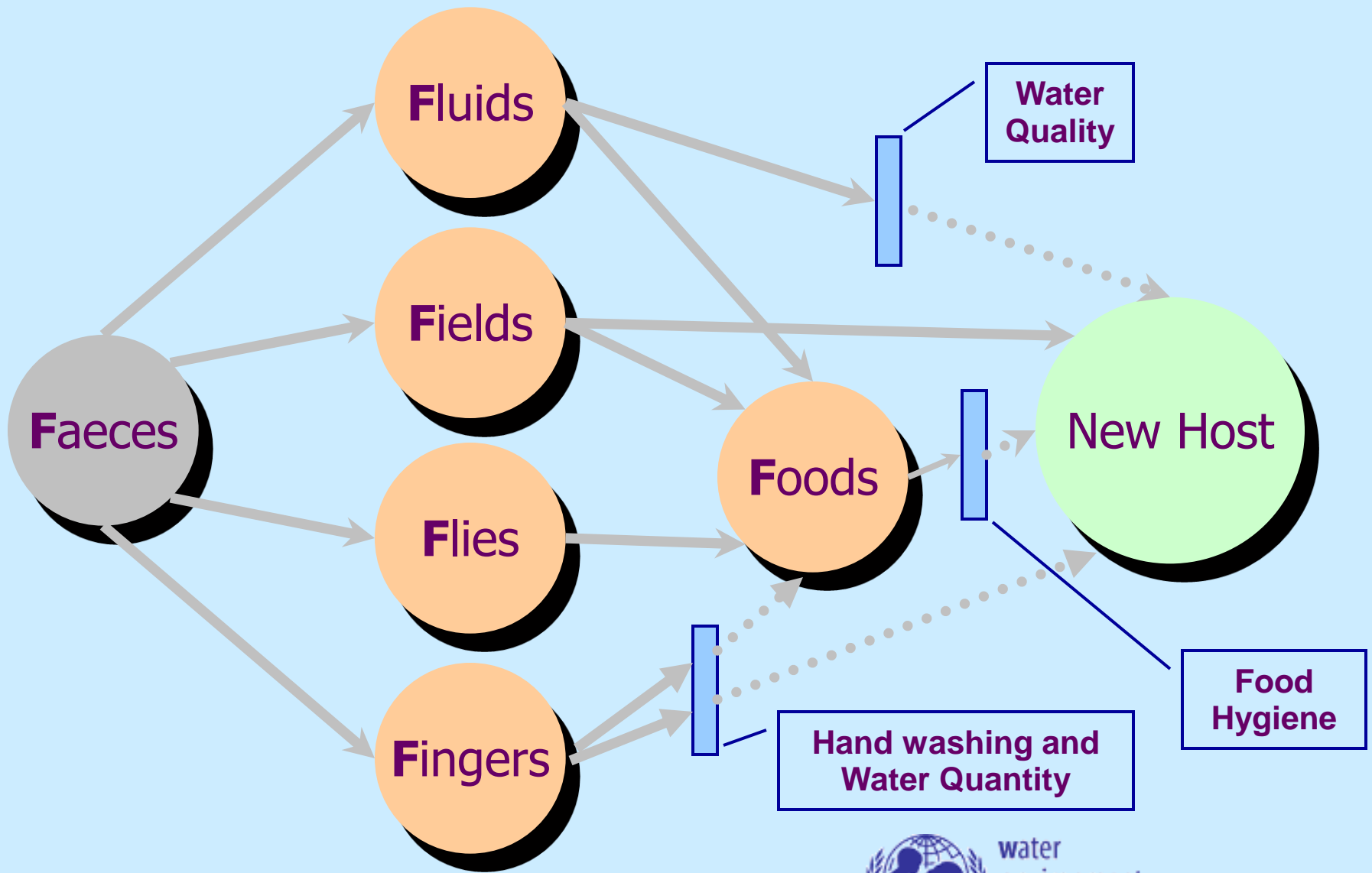
water  
environment  
sanitation

Breaking the transmission

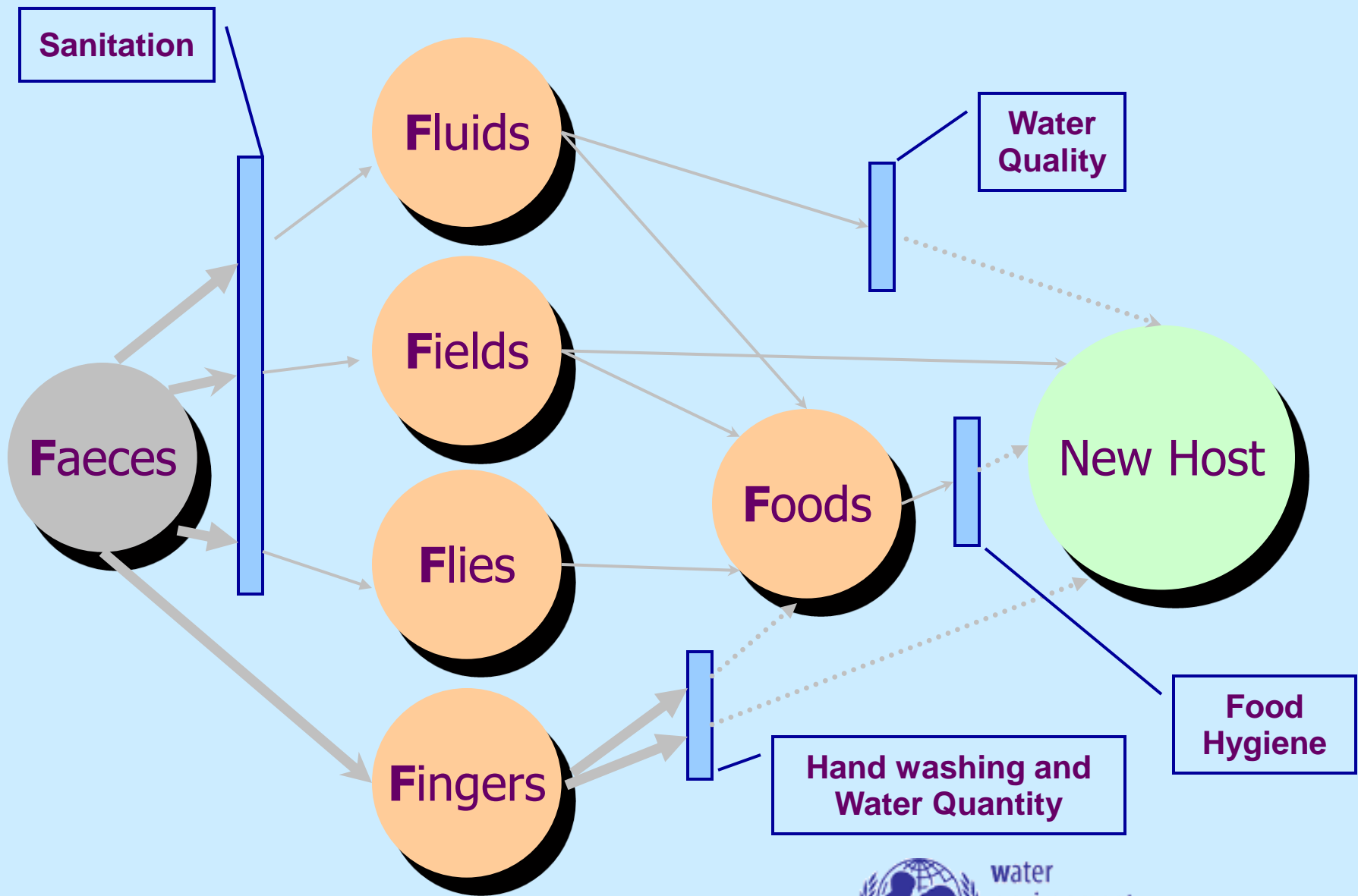


water  
environment  
sanitation





water  
environment  
sanitation



water  
environment  
sanitation



## Strategies

- Risk reduction and barrier methods
- Prevent ingestion of feces
- Provision of clean water in sufficient quantity
- Reduce risk of disease transmission from vectors
- Hygiene education

## WES Core Corporate Commitments

1. Ensure the availability of a *minimum safe water supply*, through provision of technical and material support to external implementing partners.
2. Provide *bleach, chlorine or purification tablets*, and detailed user and safety *instructions in the local language*.

## WES CCCs (continued)

3. Provide *jerry cans*, or appropriate alternative, with user instructions and messages, in the local language, on handling of water and disposal of excreta and solid waste.
4. Provide *soap* and disseminate *key hygiene messages* on the dangers of cholera and other water- and excreta-related diseases.

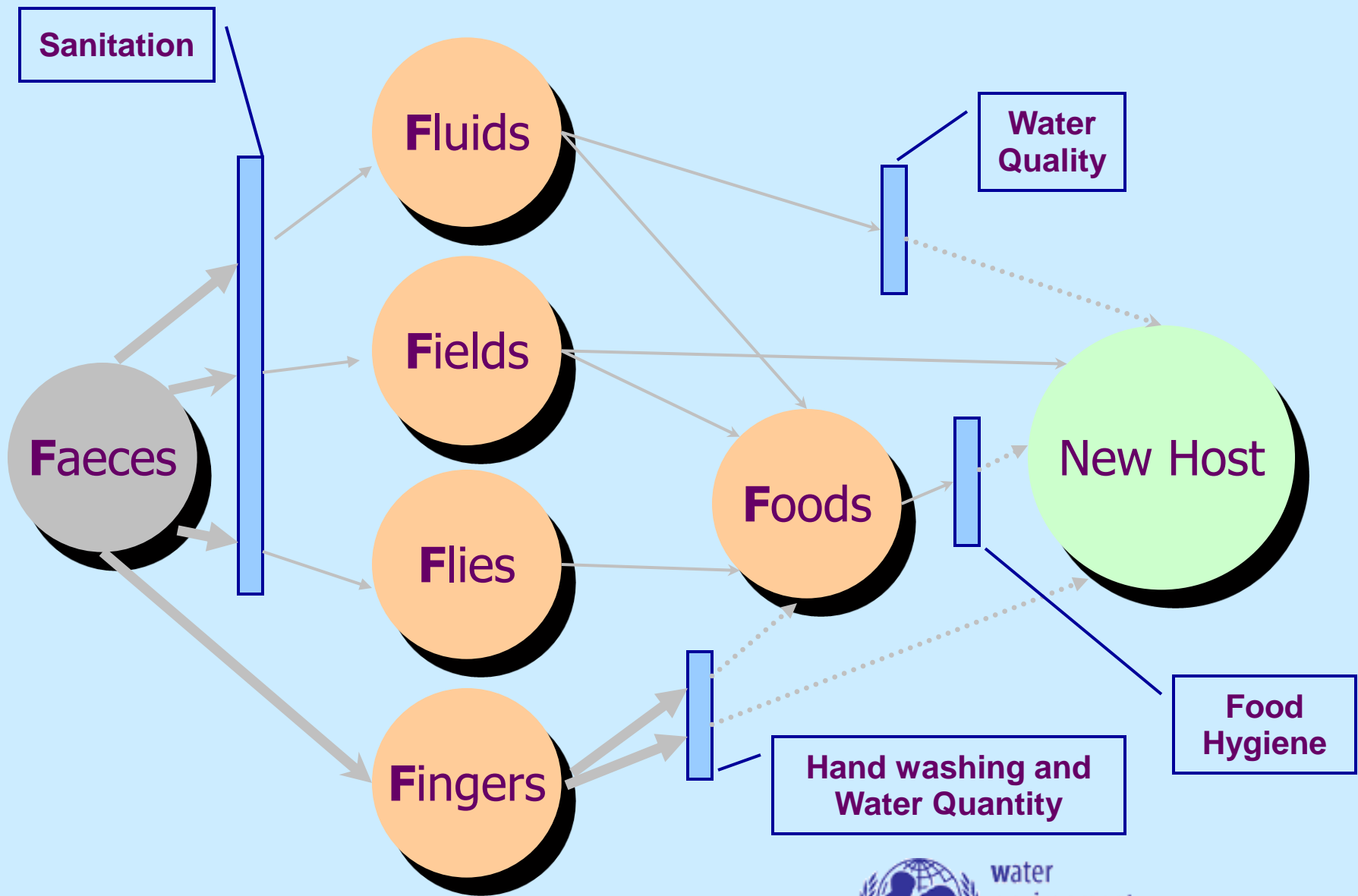
## WES CCCs (continued)

5. Facilitate *safe excreta and solid waste disposal* through provision of:
- shovels
  - cash for contracting local service companies to dispose of solid waste
  - messages on the importance of keeping excreta (including infant faeces) buried and away from habitations & public areas
  - messages on disposal of human and animal corpses
  - and instructions on, and support for, construction of trench and pit latrines

# Ranking of Interventions Based on Reduction of Morbidity due to Diarrhea

1. Sanitation (36%)
2. Hygiene (33%)
3. Water Quantity (20%)
4. Water Quality (15%)

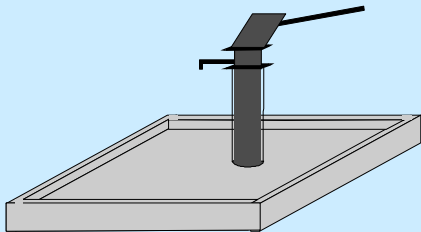
Source: Esrey et.al., 1991



water  
environment  
sanitation



# What are the needs ???



# Needs Assessments

- Data required
- Surveys (systematic and spatial)
- Organization and implementation
- Useful in all phases of relief

## *Data needed on...*

*Water*

Sanitation

Hygiene Practices

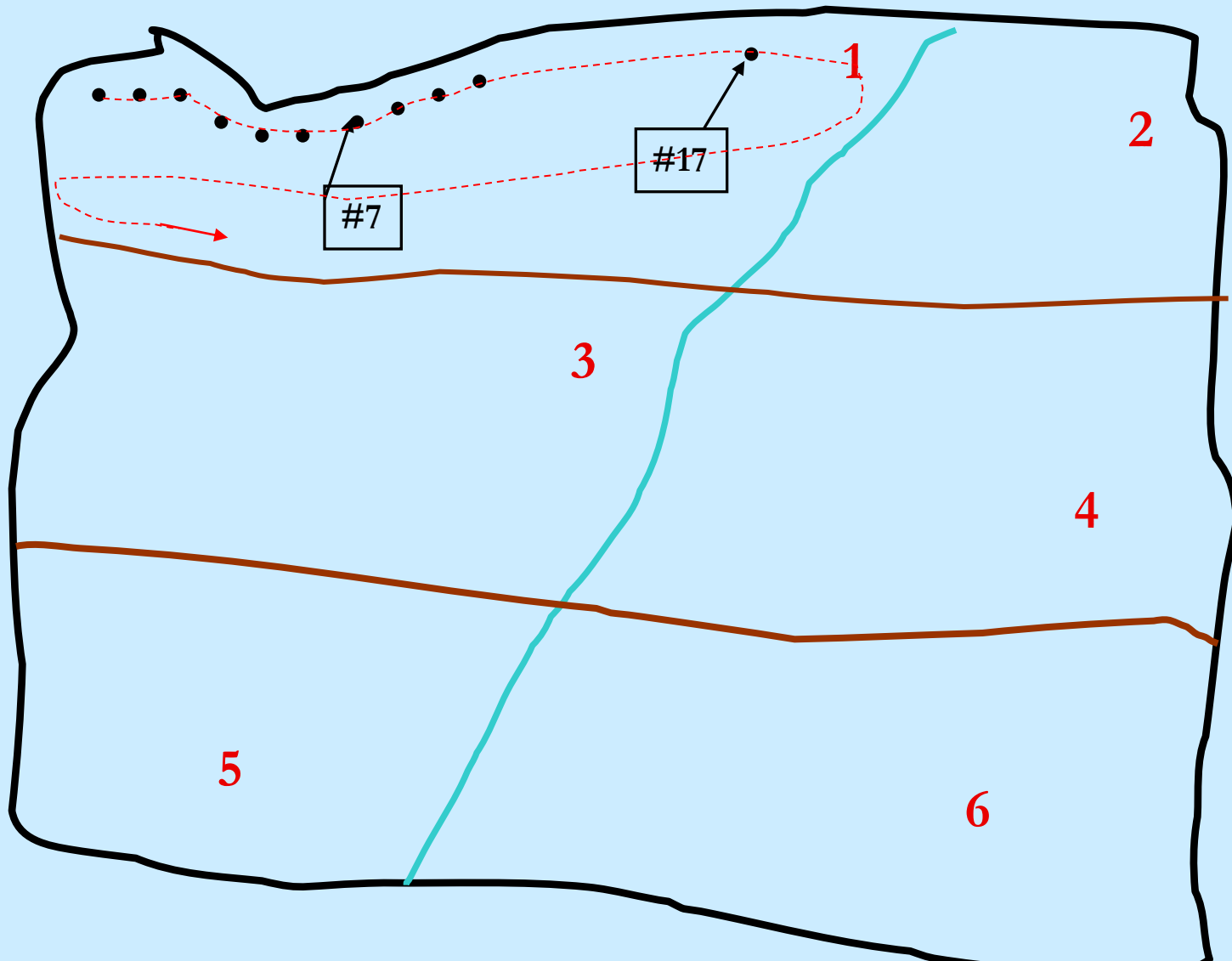
## *Minimum Data*

- Population
- Water Consumption (l/p/d)
- Water Quality (bacterial, chemical)
- Storage Containers (#/family)
- Latrine Coverage (people/latrine)
- Fecal-oral diseases or deaths
- Prevalence of Hand-Washing
- Availability of Soap
- Prevalence of vector borne diseases

## ***Systematic Survey***

- **Prepare forms and map the area**
- **Determine sample interval**
- **Move systematically through the area**
- **Ask questions at every n<sup>th</sup> household**
- **Analyze data and make decisions**

## *Systematic Survey*



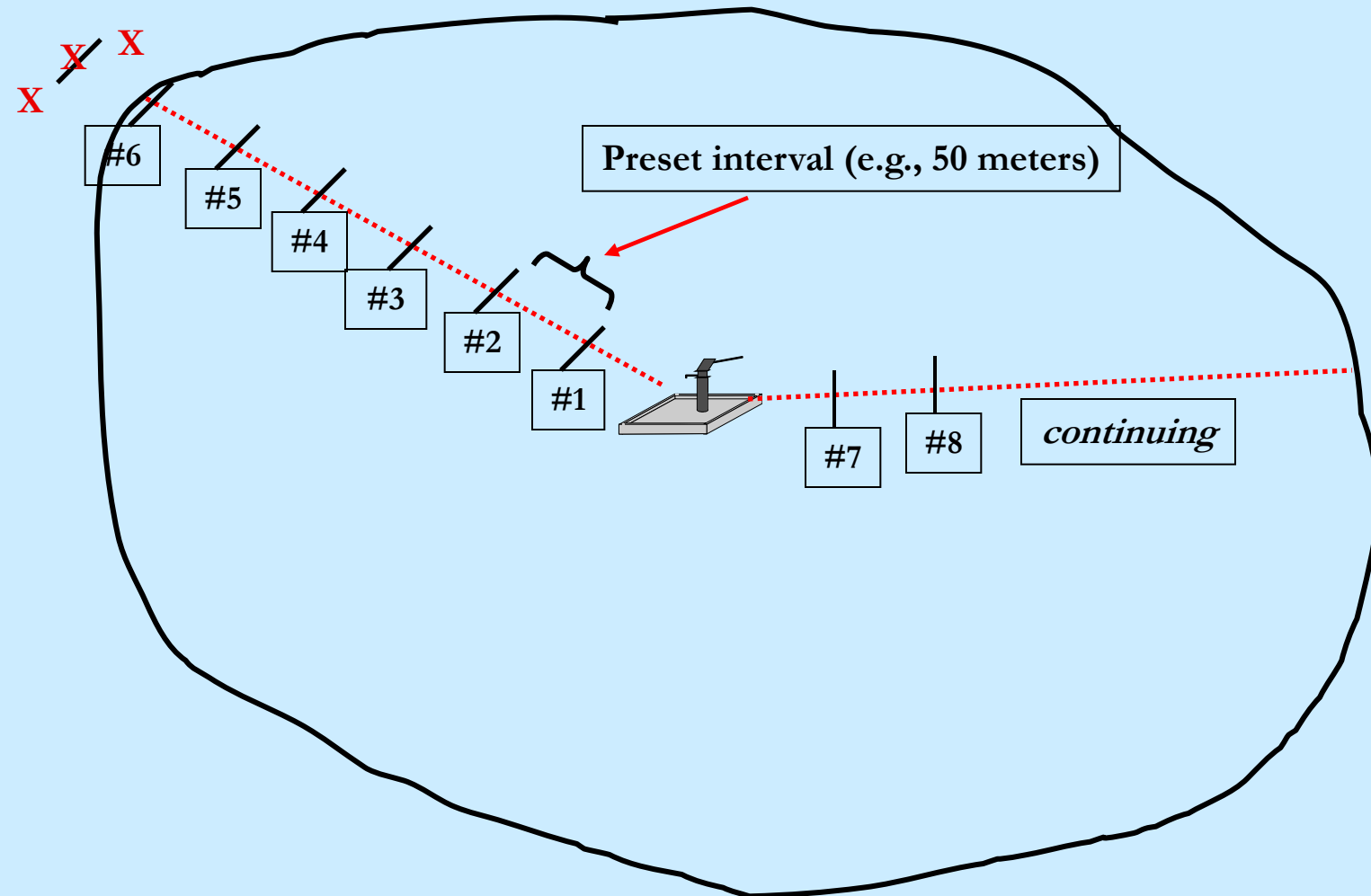
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## ***Spatial Survey*** ***Around a Water Point***

- **Prepare forms**
- **Estimate source yield (l/day)**
- **Select radial and distance interval**
- **Move along radial and interview**
- **Upon reaching periphery, select new radial**
- **Interview 10 – 20 households**
- **Analyze data and make decisions**

# *Spatial Survey Around a Water Point*



# *Practical Exercise Estimation Problems*

# *Hygiene Promotion*



*Even in an emergency ????*

## *Key Activities*

- *Hygiene Kits*
- *Information campaigns \*\**
- *Community mobilization*
- *Household cleanliness*
- *Cleanliness of public areas*

# Hygiene Promotion

## SIMPLE MESSAGES

- Hand washing
- Proper Disposal of Feces
- Protection of Drinking Water



*But not without "stuff"...*

# *Family Hygiene Pac*

- Collapsible container or bucket
- Bar soap
- Purification tablets
- Instructions for use of purification tablets



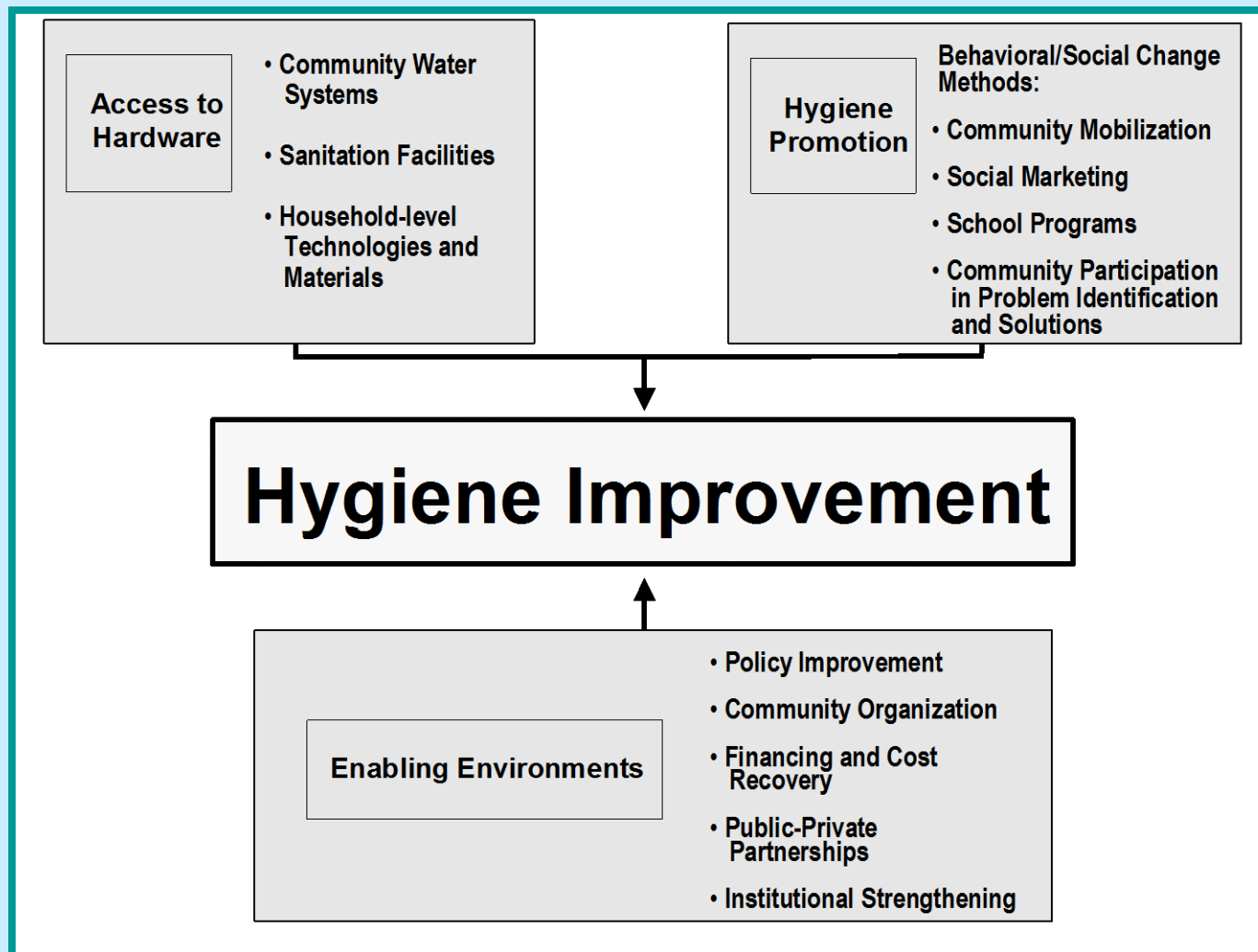
## *Hygiene Pac #2*

- Collapsible container
- Bucket (incl lid preferred)
- Bar soap
- Purification tablets
- Instructions for use of purification tablets
- Plastic sheeting
- Plastic sanplat
- Folding shovel
- Wash basin
- Towel
- Baby diapers

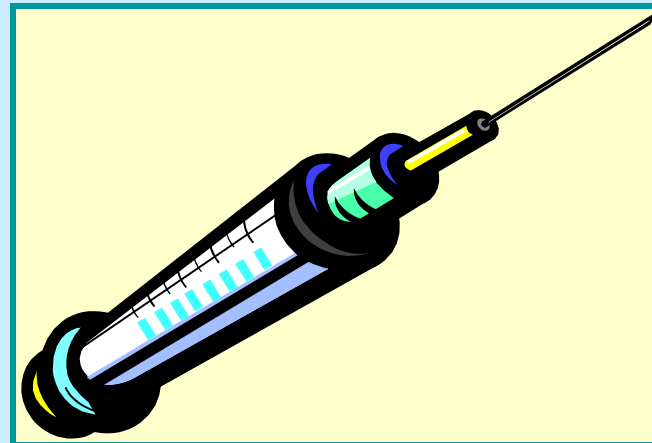
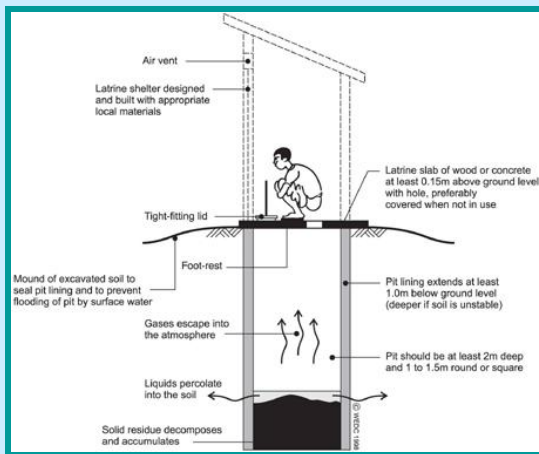


# *Hygiene Improvement Framework*

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# *Emergency Sanitation*



## Objective of Emergency Latrines

To safely contain human excreta which are key transmission mechanisms for communicable diseases.

# Requirements for a Good Emergency Latrine

Fast *and* easy to build

Acceptable to the  
target group

Use local materials and  
skills

Adaptable to  
various locations  
& situations

Low maintenance  
and operation  
cost

# Emergency Latrines

Defecation field

Defecation trench

Community pit latrine

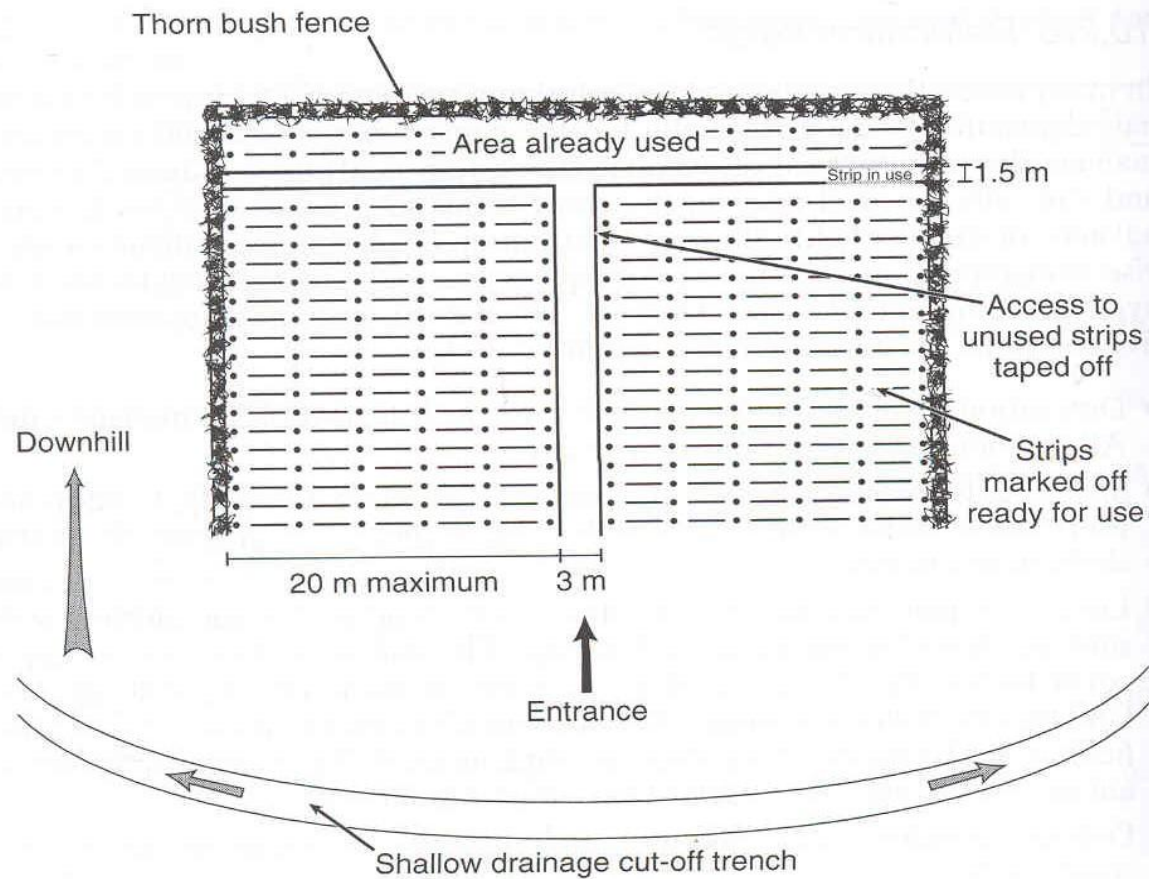
Family pit latrine

Mobile latrine

**\*\* Always seek to improve the situation**

# Defecation Field

162 Environmental sanitation





# Defecation field

## *Advantages*

Fast and easy to build

Use basic materials

## *Disadvantages*

Not appropriate in many communities

Only suitable in very hot and dry climates

Poorly maintained fields may become a health hazard

Must be well controlled

# Defecation Trench

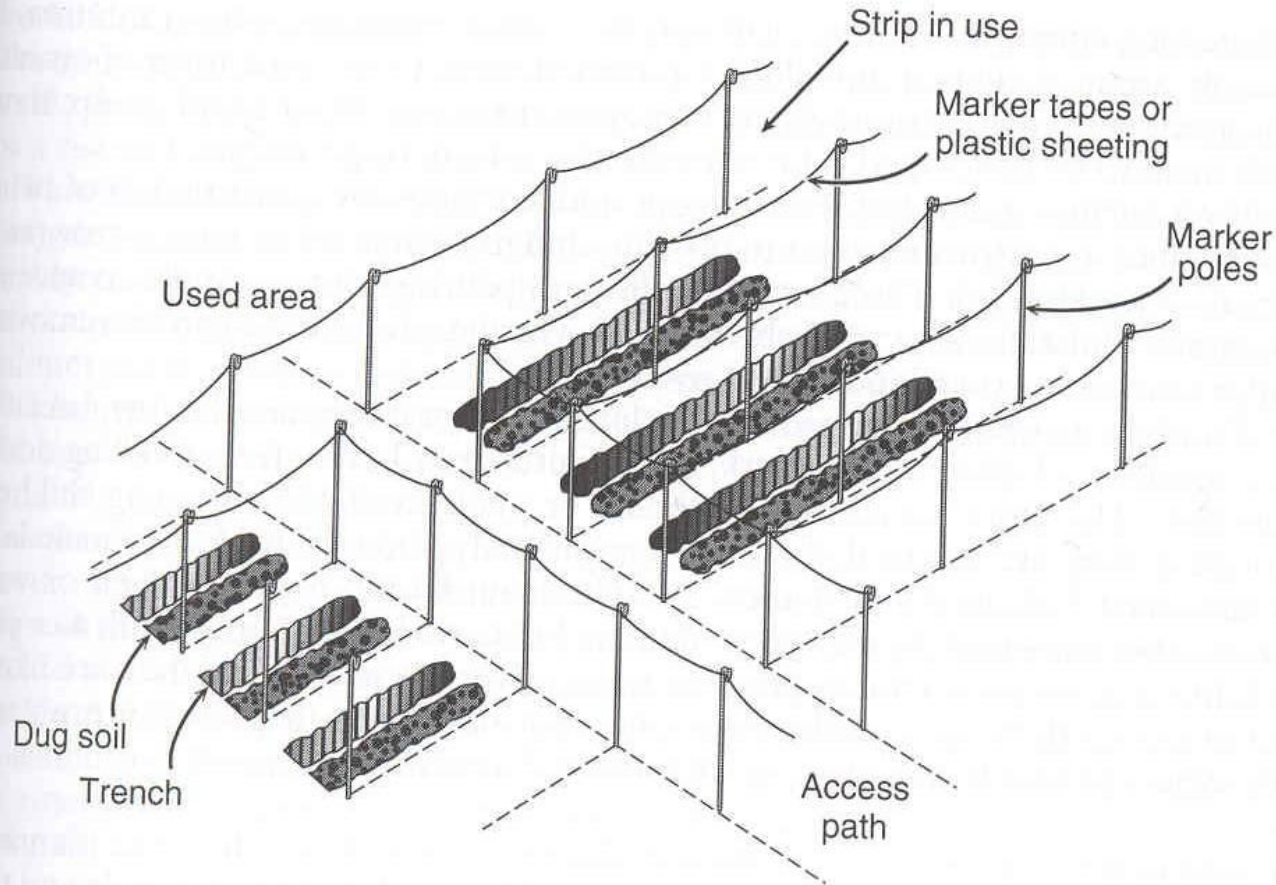


Figure 10.2 A trench defecation field

Source: Reed, 1994



# Defecation Trench

## *Advantages*

Improvement on  
Defecation field

Excreta easily covered

Pathways can be kept clear

Reduction of vectors

## *Disadvantages*

Intense management &  
Supervision

More labor intensive

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## PUBLIC HEALTH & NUTRITION in EMERGENCIES

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# *Community Pit Latrine*



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# Community Pit or Trench Latrine

## Advantages

Fast depending on type of soil

Easy to build

Use basic materials

Suitable in most situations

## Disadvantages

Ownership versus maintenance

Vector problem





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## Family Latrine and Bath Shelter



# Family Pit Latrine

## *Advantages*

Fast depending on type of soil

Easy to build

Use basic materials

Suitable in most situations

Ownership

## *Disadvantages*

Poorly maintained latrines can become a health hazard

Vector problem



## Emergency Family Latrines (200 L Drums & Concrete Rings)

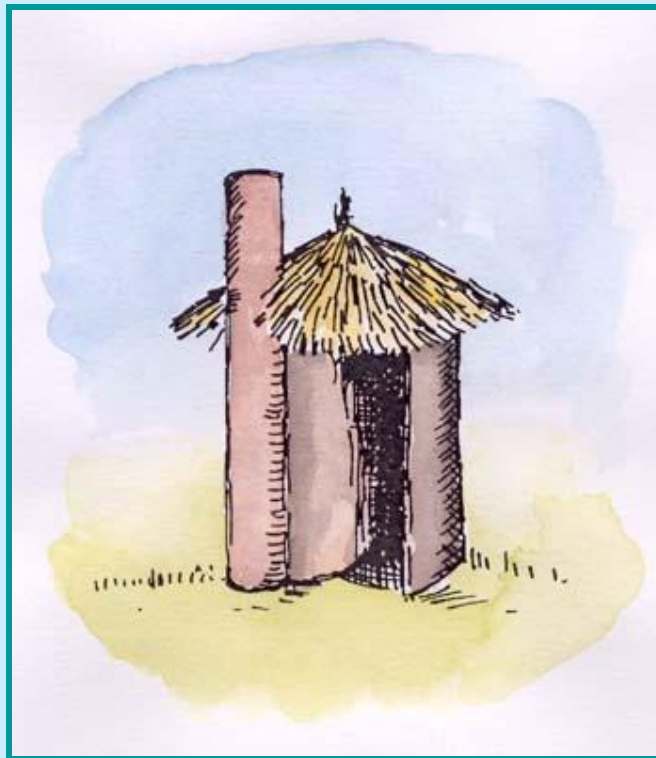




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Real World



Small Dream

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# ***Mobile Latrines*** ***(chemical latrines)***



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# Mobile Latrine

## *Advantages*

Fast and easy to set up

Suitable in more  
developed countries

## *Disadvantages*

Very expensive

Need good logistical  
support

Not appropriate in  
some remote areas

# Common Standards with Respect to Emergency Latrines

- 20 people per latrine
- Distance from water source = 30 m
- Distance from shelter = 50 m or 1 minute walk (maximum)
- Arranged by household
- Separate toilets (men & women) available in public places
- 1.5 meters above water table
- Adequate drainage
- Sludge accumulation rate  $\simeq 0.06 \text{ m}^3$  per person per year
- Life of latrine??

# Latrine Program Considerations

- Cultural norms
- Children and Women
- Maintenance
- Security / Lighting ??
- Community Contribution
- Tools
- Crews (volunteer or hire)
- Drainage
- Hand washing  
(water & soap)
- Anal Cleansing
- Design options
- Slabs

# *Slab Options*

- **Materials**

- *Plastic*
- *Wood*
- *Concrete*
- *Reinforced Concrete*

- **Production Methods**

- *Mass Produced*
- *Individually produced*



# *Pour Flush Squat Plate*



UNU

# *Plastic Slabs*



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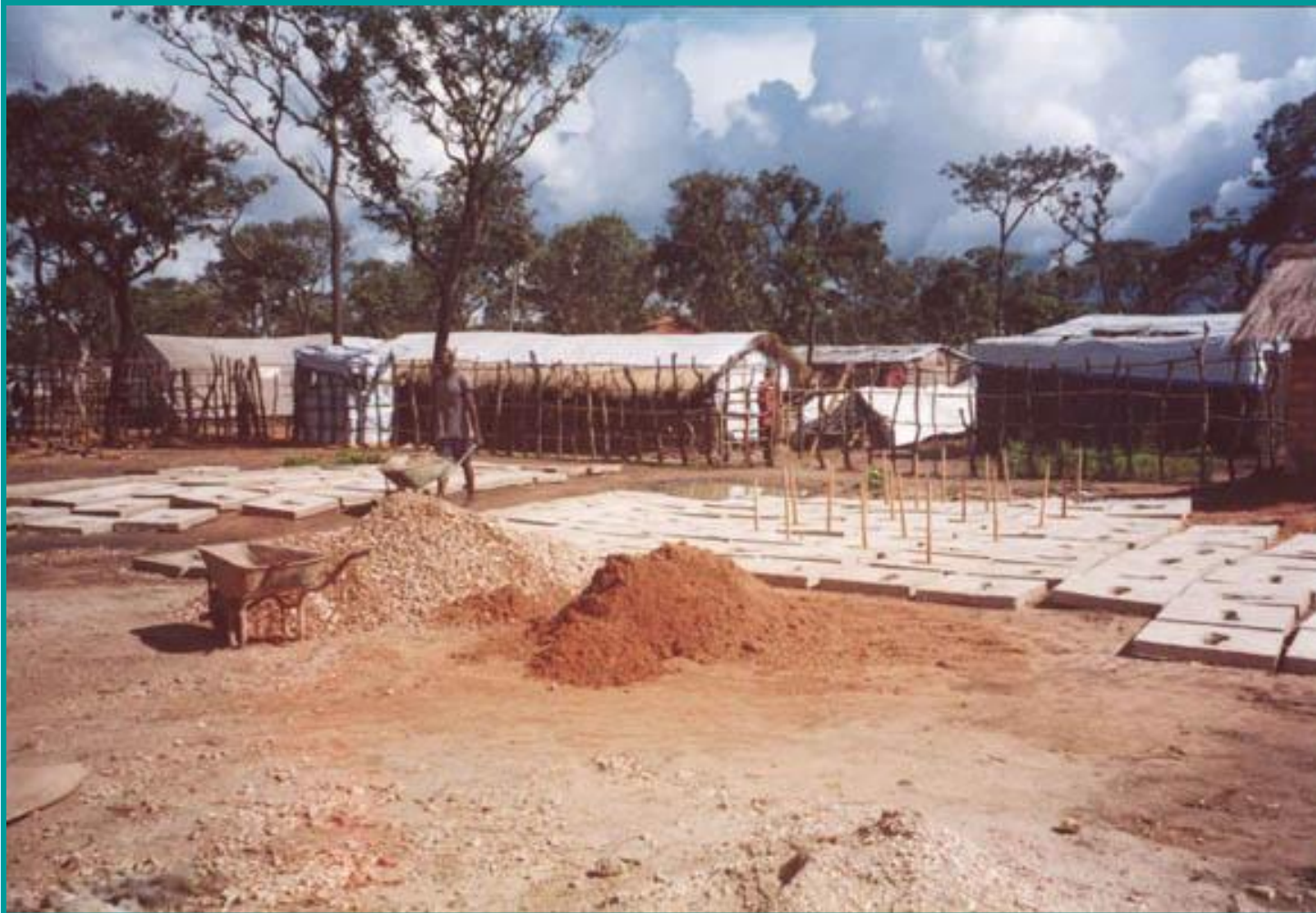
# *Dome Slabs*





# ***Mass Production Rectangular Slabs***

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## Mozambique Refugees, 1992

	Chambuta, Zimbabwe	Lisungwe, Malawi
Diarrhea Mortality (/10,000/day)	1.5	0.25
Water Availability (l/p/d)	17	11
Chlorination	100%	20%
Persons/latrine	290	14

*Case Study*  
*Eastern Nepal*

# Rubbish Disposal Schemes (Common)

Clean Up Day (Done by every refugee)

Regular rubbish collection and disposal  
(Done by refugee sanitation workers)

Disposal Sites

Standards (100 liter container/10 families OR rubbish pit within 15 meters – refer to SPHERE)

Areas of concern (homes, markets, slaughter sites, health centers, schools, communal disposal sites)

# Medical Waste Disposal Schemes (Common)

Burnable Solid Waste: burn in an incinerator

Non-burnable Solid Waste: put it in a container and bury it in a medical waste pit.

Liquid Waste: septic tank system

Epidemics (disinfection, wastes, sullage, bodies)



## Temporary Incinerator



## Permanent Incinerator







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## Biohazardous Waste Pit





# Waste Water Disposal

- Where
- Why
- How



Excavated earth is bedded to protect soakpit from surface water

Raised edge 0.1m high

12mm (1/2") bibcock

Drain at least 3m length with good slope and stone foundation with surface plaster of cement mortar

Soakpit filled with large stones with smaller stones on top

Stone foundation voids compacted. Concrete surface plastered

Standpipe 200mm off centre of apron

0.4m

0.6m

0.75m

Earth backfill

Section on A-A

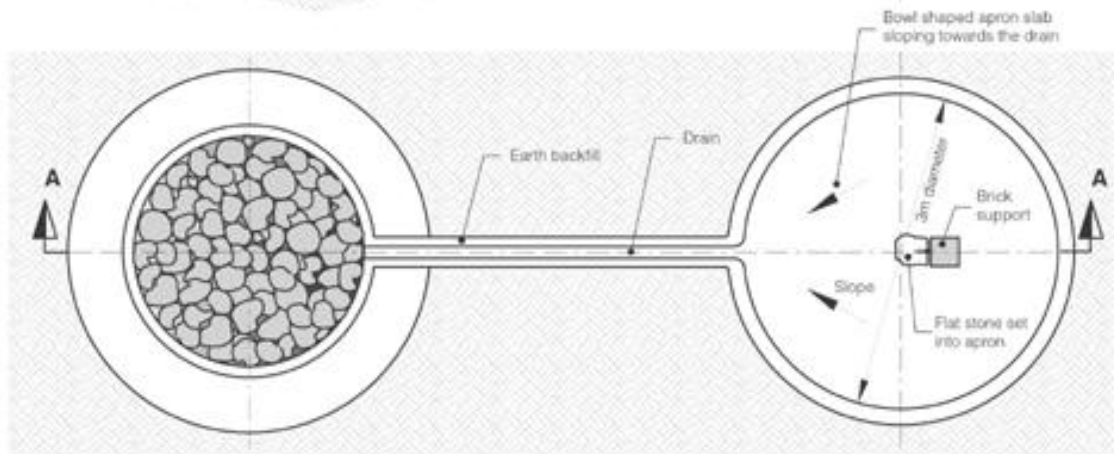


Figure 8.1 An example of a stone-filled soakpit used for a public standpost (after DLUW (1983))

# Soak Trench

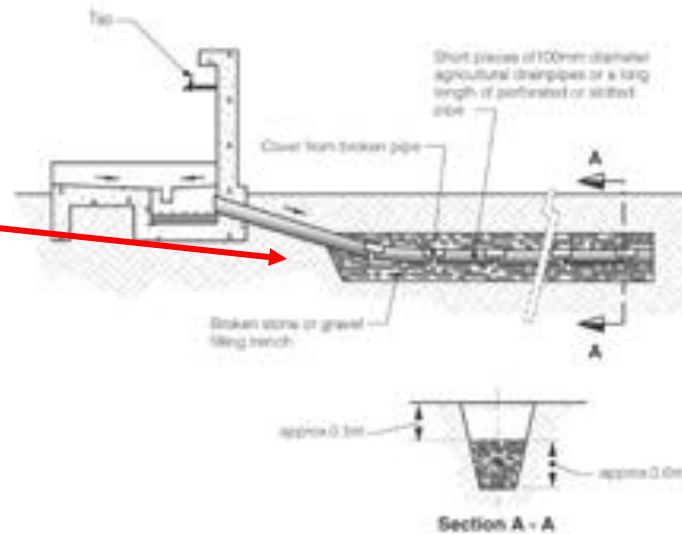
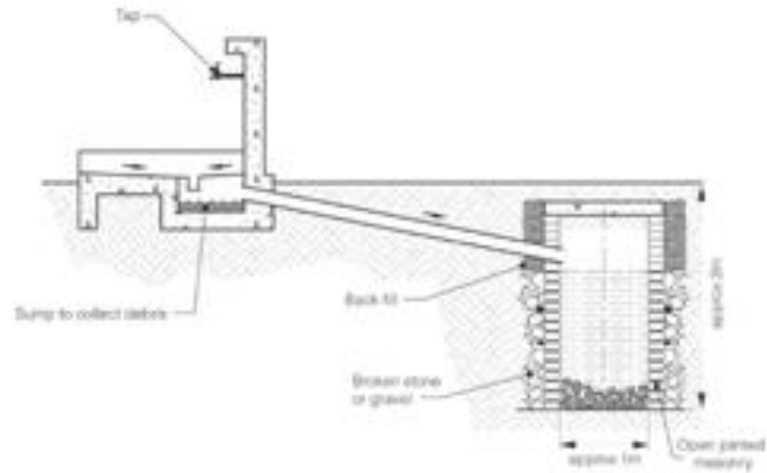


Figure 5.2 Soakage systems for disposal of wasted water



# *Wastewater for Irrigation*



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# *Water Supply and Treatment*



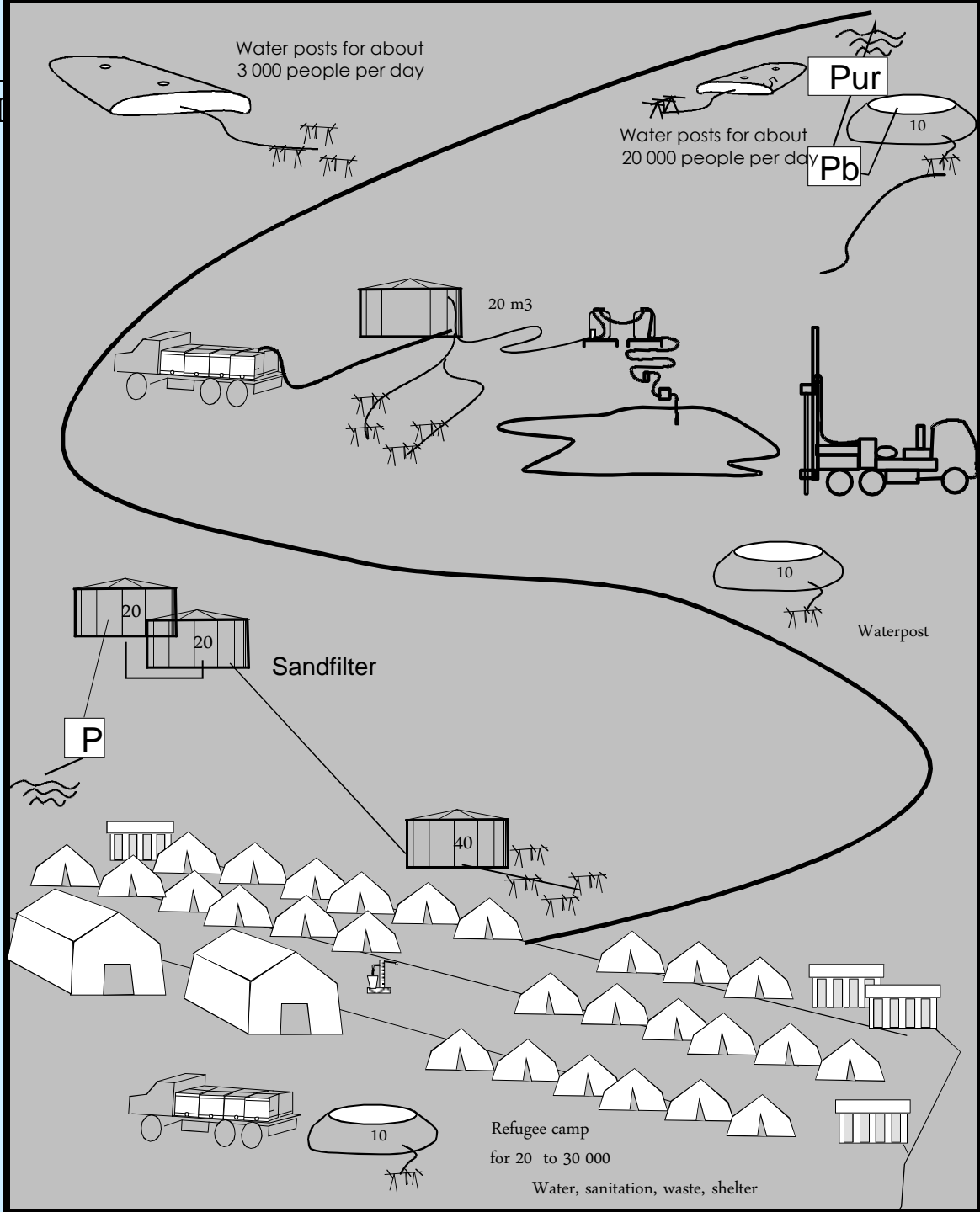
# Requirements of a Good Emergency Water System

- Fast and easy to build
- Low maintenance and operation costs
- Adaptable to various situations
- Uses local materials and skills



# *Water Production Process*

- Abstraction
- Pre-treatment
- Treatment
- Distribution
- O & M
- Wastewater Mgmt



# Criteria For Selecting a Water Source

## Water Quantity

- Capacity
- Supply to local community ??
- Reliability of supply over time

## Water Quality

- Water Purity
- Risk of Pollution

## Engineering

Speed at which it can  
be done  
Appropriate &  
ease of maintenance  
Use local materials

## Cost

## Security

# Emergency Water Supplies

Rehab of pre-existing systems

Piped water systems (*gravity fed or pumped*)

Shallow well

Trucking

Other (rainwater, springs)

*\*\* Surface versus Groundwater*

*\*\* Quality versus Quantity*

# *Piped Water System*

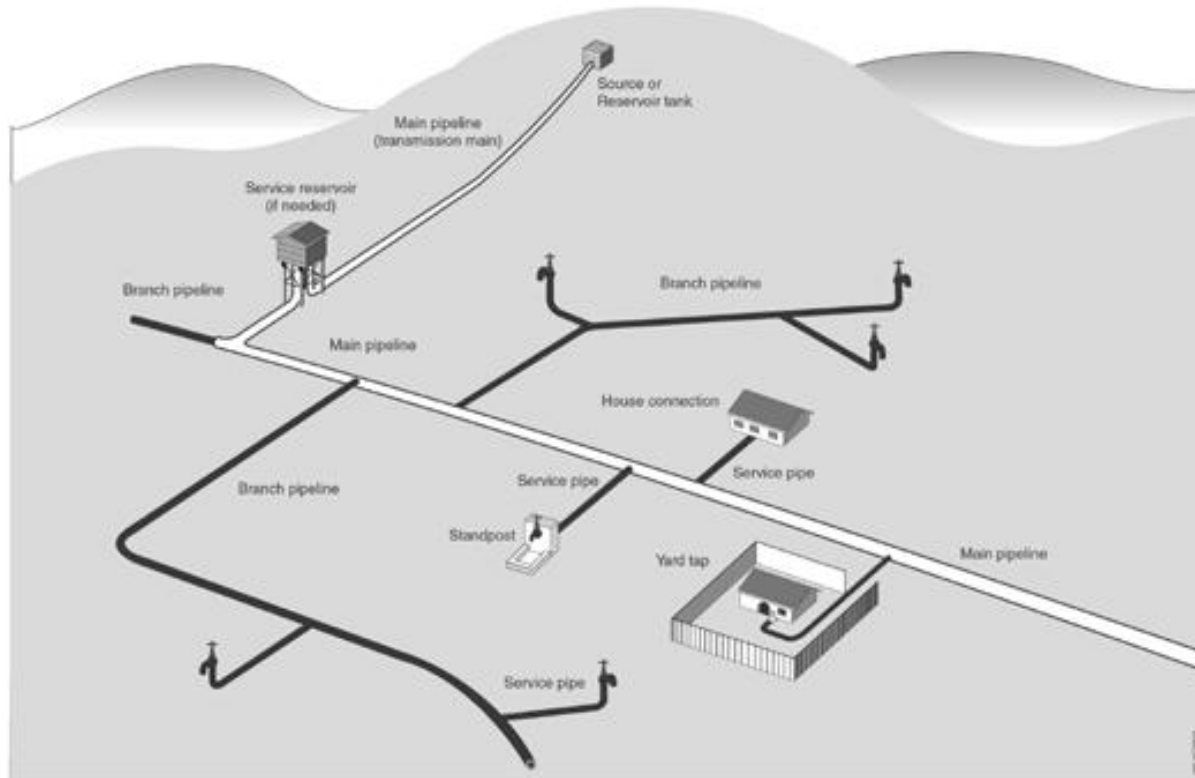


Figure 9.1 - Pipework which makes up a distribution system

*\* Use of emergency equipment in system construction*

# Gravity Fed Piped Water System

## *Advantages*

Fast and easy to build

Uses local materials & skills

Low construction and  
O&M costs over time

## *Disadvantages*

Requires elevation  
differences

Can be seasonal

Large scale offers  
Challenges & risks

***\*\* Treatment depends on source***



# Gravity-Fed Water System



# Mechanical Pumped Water System

## *Advantages*

Fast and easy to set up

Suitable in areas where  
the main water source is  
surface water

## *Disadvantages*

High operation and  
maintenance costs

Need good logistical  
support

***\*\* Treatment depends on source***

## *Emergency Equipment and Kits*

- *Tanks*
- *Bladders*
- *Tap stands*
- *Pumping / Treatment Systems*



## *Water Tank Kits*









## *Bladders*







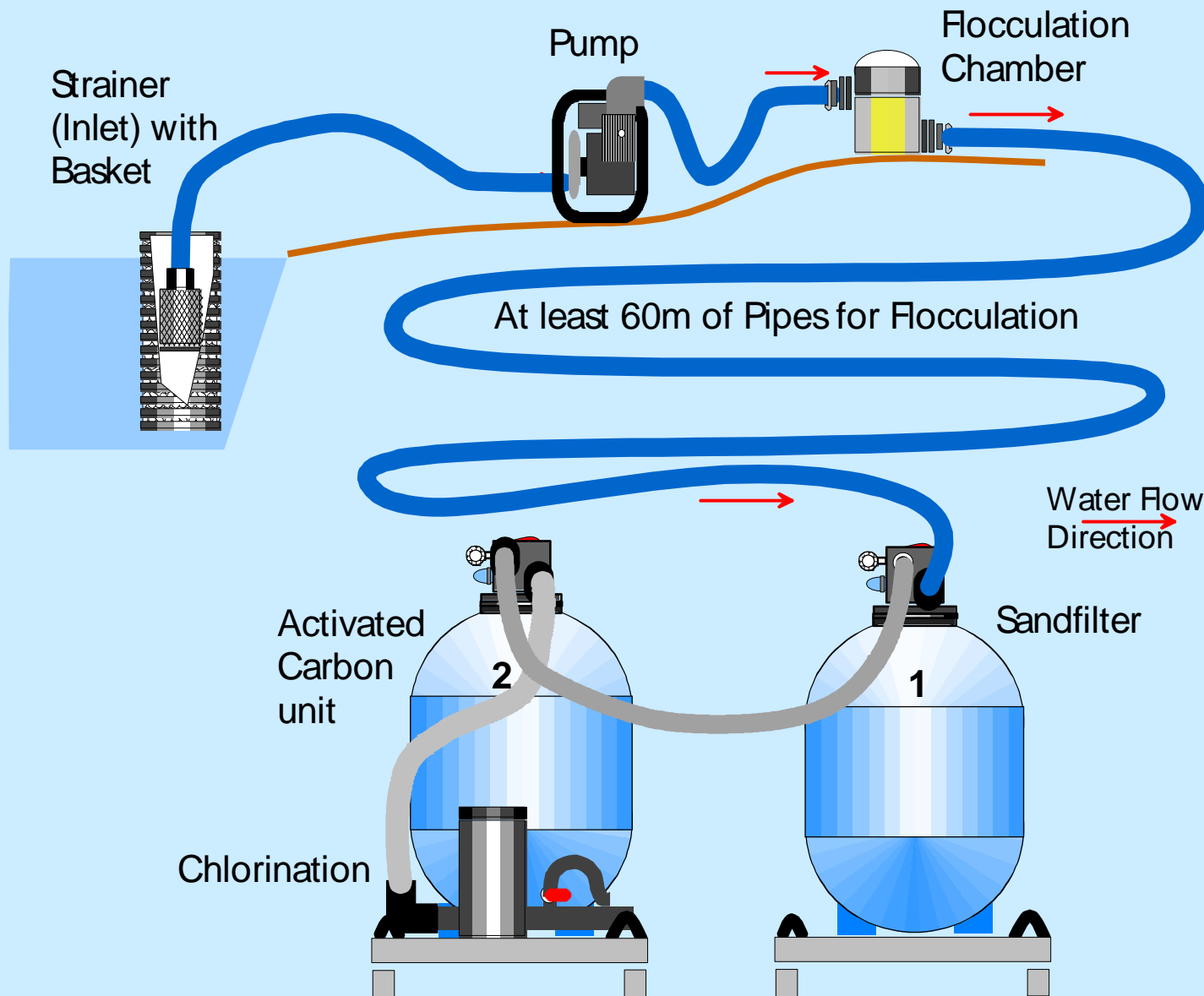














# Shallow Wells

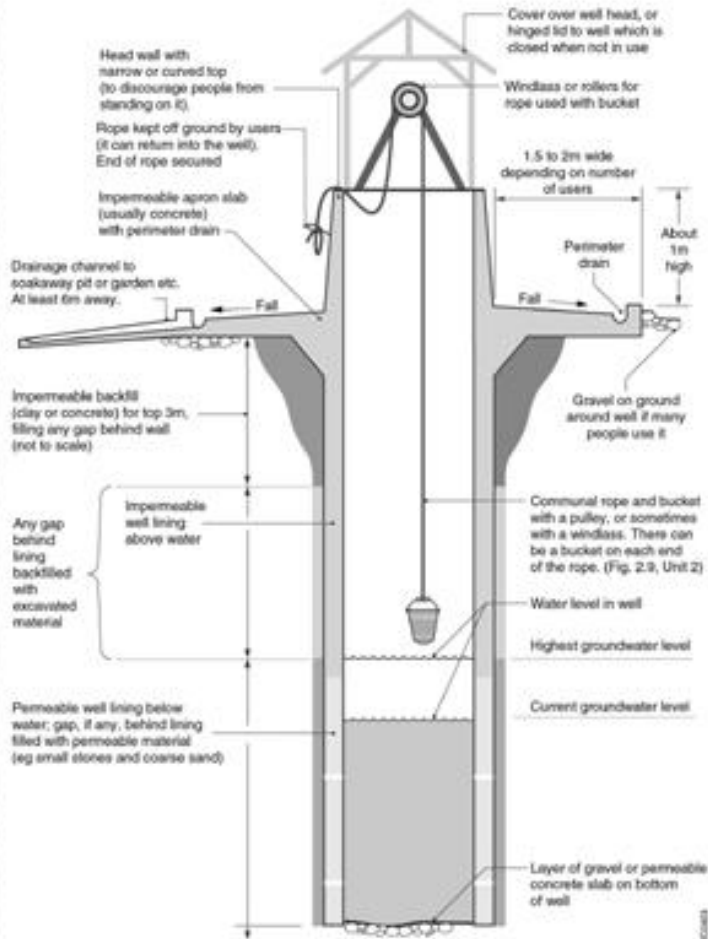


Figure 4.3. Good features open wells



# Emergency Shallow Well

## *Advantages*

Fast and easy to construct

Use local skills & materials

Usually provide fairly clean water

## *Disadvantages*

Suitable in area where water table is high

Sometimes seasonal

Prone to contamination if not protected





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*Thoughts???*



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# *Trucking Water*





# Trucking Water

## *Advantages*

Fast and easy to set up

Can transport water very long distance

## *Disadvantages*

Very expensive

Only appropriate for short term solution

Must have access to good road

*\* Tankers or bladders on flatbeds*





## *Chaos...*

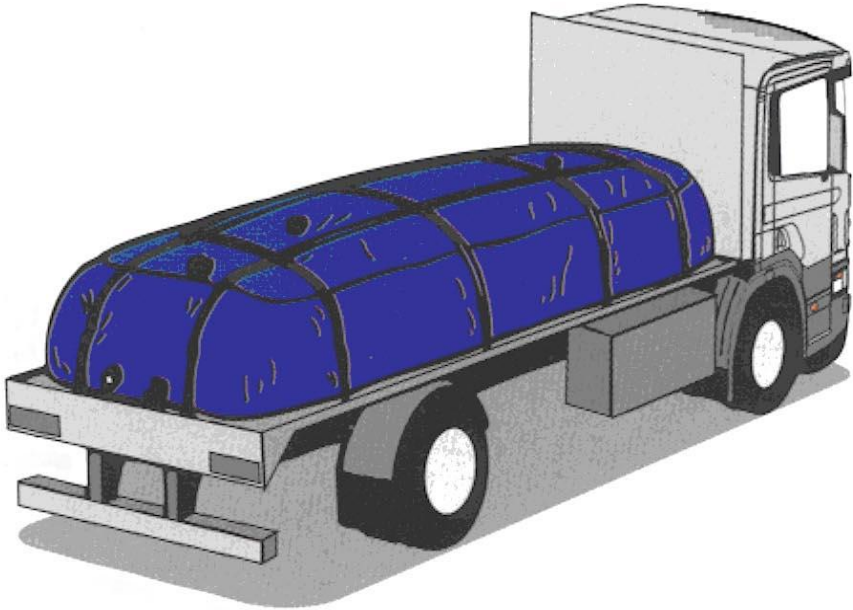


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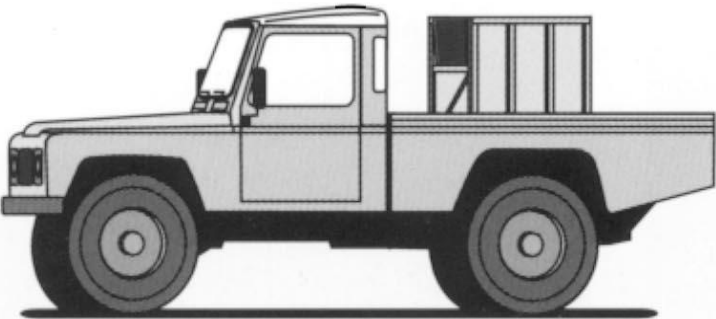


**Bladdertank for transport**

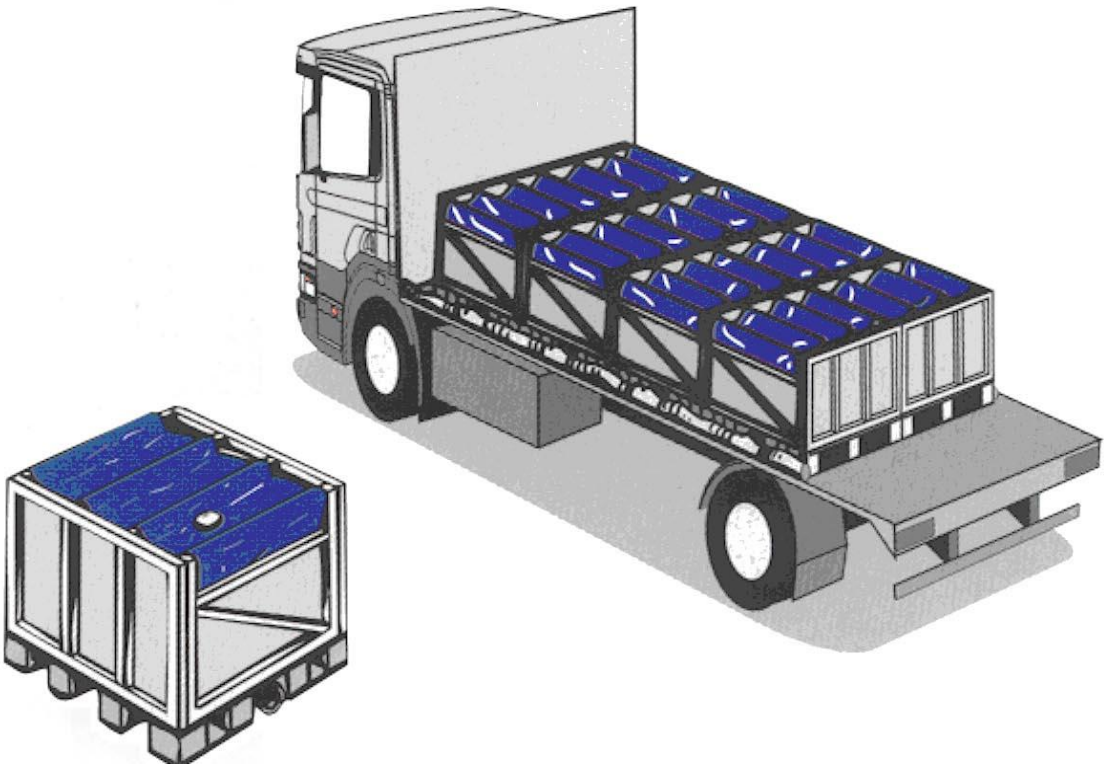
<i><b>Capacity</b></i>		<i><b>Shipping Data</b></i>	
	<i><b>Qt.</b></i>	<i><b>m<sup>3</sup></b></i>	<i><b>kg</b></i>
3500 L	2	0,39	96
7500 L	2	0,39	145



**Palltank for transport**



<i><b>Capacity</b></i>		<i><b>Shipping Data</b></i>	
	<i><b>Qt.</b></i>	<i><b>m<sup>3</sup></b></i>	<i><b>kg</b></i>
1000 L	1	0,42	96



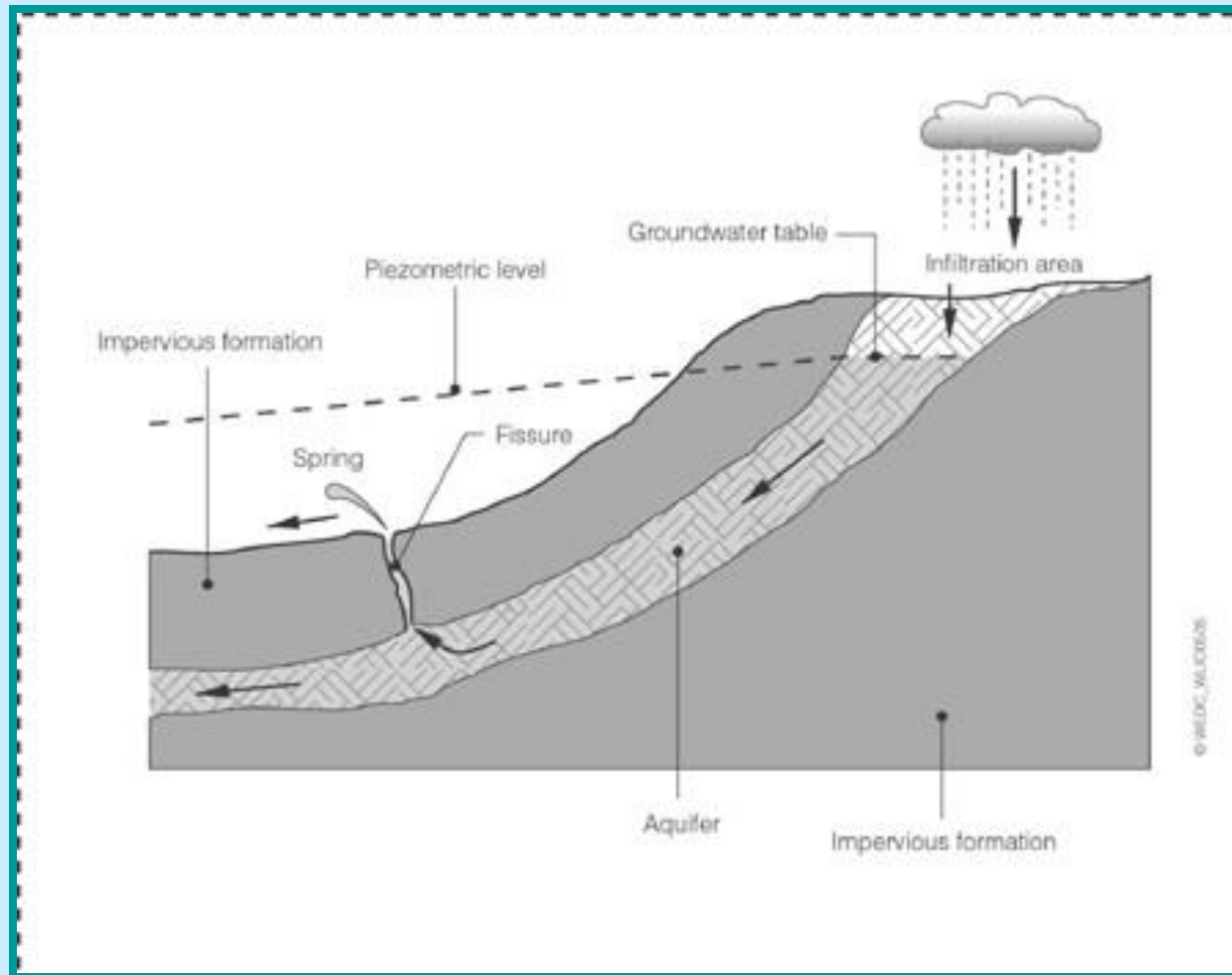
*Case Study*  
*East Timor*

## ***Other Sources***

- Springs
- Rainwater Catchment
- Boreholes
- Traditional Sources



# *Spring Protection*





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# *Rainwater Catchment System*







*Tapstand*

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# *Borehole*



# Traditional Methods

## Karezes - Afghanistan

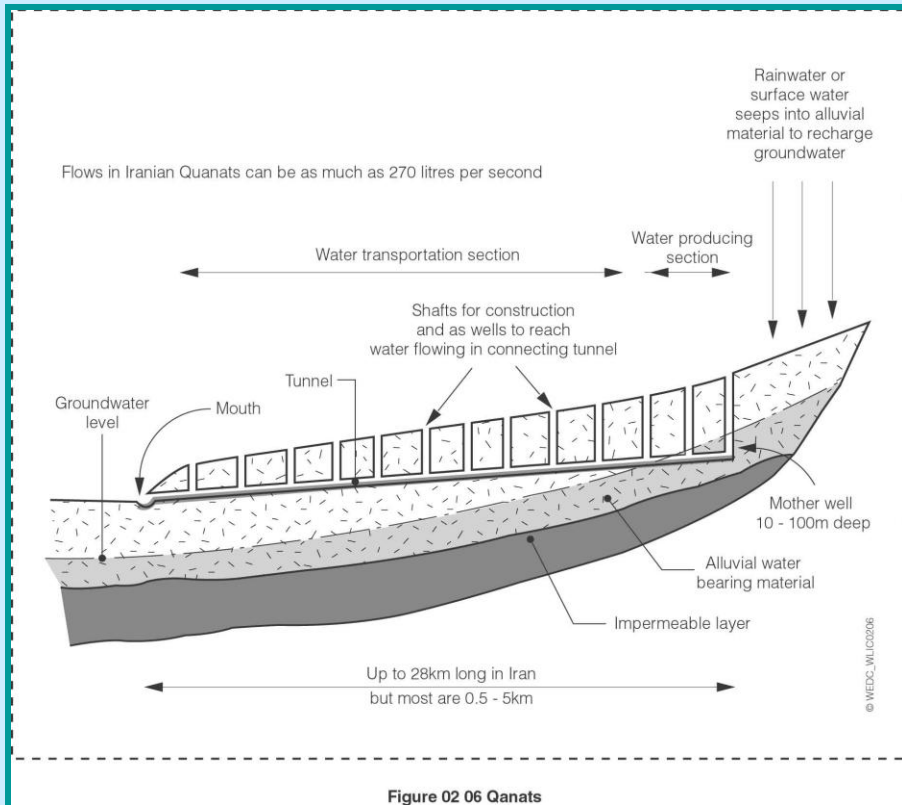


Figure 02 06 Qanats





## *Haffir Dams - Ethiopia & Sudan*



# Common Standards with Respect to Water Supply Access

- 250 people per tap
- Source < 500 m from shelter
- Water collection and storage containers  
(2 collection vessels + 1 storage vessel per family)

## Common Water Quantity Standards

***SPHERE: 15 l/p/d***

***UNHCR:***

- 15-20 l/p/d*
- 7 l/p/d (minimum for survival)*
- 5 l/p/d (health clinic outpatient)*
- 40-60 l/p/d (clinic inpatient)*
- 20-30 l/p/d (feeding patient)*
- 2 l/p/d (pupil)*
- 15-30 liters per head of livestock*
- 1 l/second/hectare (irrigation)*
- 3-6 l/m<sup>2</sup> (vegetable gardens)*



# Common Water Quality Standards in Emergency

*Microbiological* (fecal coliforms = 0)

*Physical* (turbidity, smell, taste)

*Chemical* (arsenic, fluoride, iron,  
manganese, nitrates, total dissolved  
solids, hardness, pH)

*\* Water Quality Testing*

# Methods of Improving Water Quality

Protect water source

Fast, easy & inexpensive

Sustainable

Slow sand filtration

Slow

Takes time to set up

Good water quality

Storage/Sedimentation

- Fast, easy & inexpensive
- Some physical & bacteriological effect

Boiling water

time (10 minutes)

Fuel (1 kg of wood per liter)

***Chlorination (bulk & container)***

Fast, easy & inexpensive

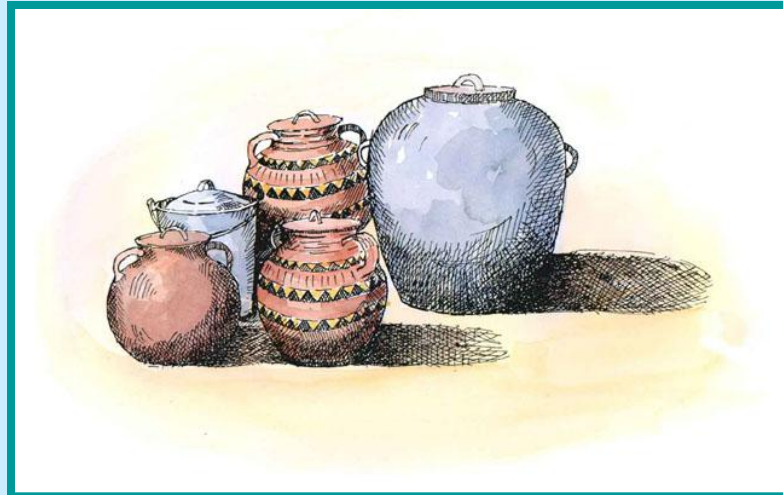
***Individual Sachets***

# Water Testing Kits





**A major source of contamination...**



## Nyamithuthu Camp / Malawi

- Annual cholera outbreaks from 1990 - 1993
- 400 households in camp of 65,000 people interviewed
- 1/4<sup>th</sup> given narrow neck buckets
- At source, mean FC = 8 FC/100 ml
- After collection, 140 FC/100 ml for large neck  
25 FC/100 ml for narrow neck
- Median bucket rinse = 800 FC/100ml
- Median hand rinse = 2500 FC/100ml
- New buckets reduced FC by 69%
- Associated with 31% less diarrhea in children < 5 yrs

# Why should water be chlorinated?

Poor water quality is one of the main causes of high morbidity and mortality in emergencies

To make sure that water is safe to consume

Fast , easy and cheap method

Provides protection against contamination after collection



# What types of water should be chlorinated?

## ALWAYS

Surface water: streams, rivers, ponds

Poorly sited shallow wells  
(too close to polluted sources)

## DEPENDS ON QUALITY

Deep and shallow wells

Spring & rain water

# What types of water can be chlorinated?

All water to be chlorinated should be fairly clear: turbidity  $< 5$  NTU or (backpack method) put your whole arm into the water; if you can still see the tip of your finger, it is O.K.

High Turbidity: Should improve the turbidity of the water by:

- Storage

- Filtration

- Add aluminum sulphate (Coagulation & Flocculation)

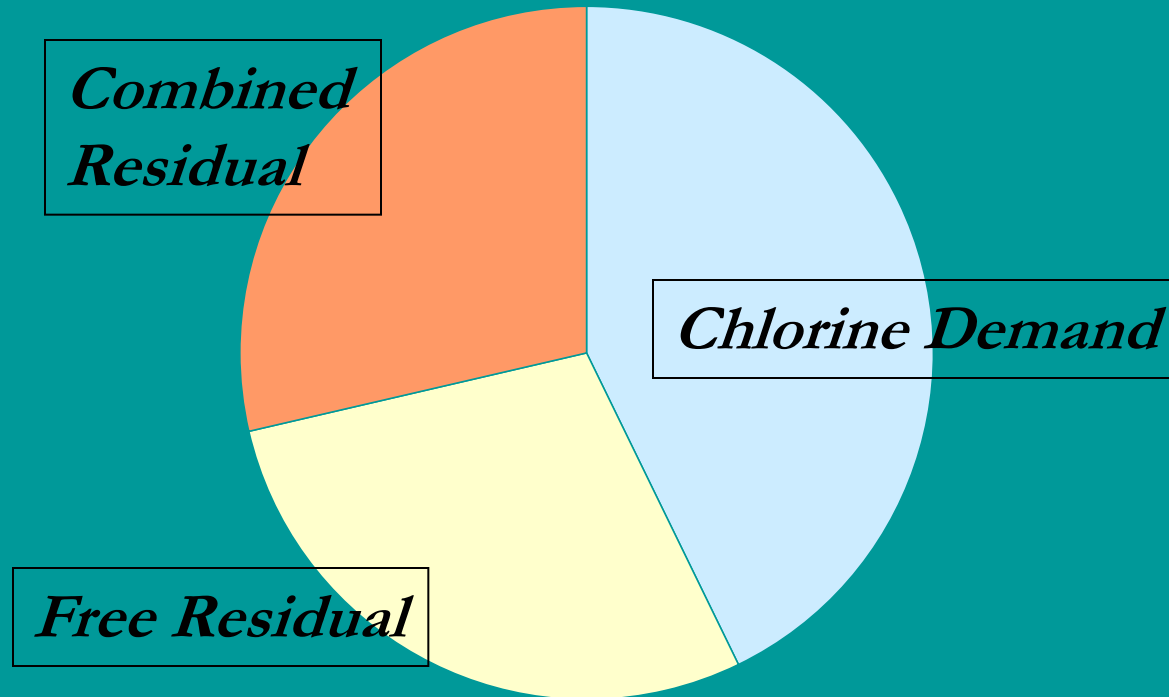
# Standard Chlorine Concentration Requirements

At least 30 minutes contact (mixing) time

0.2 – 0.5 mg/liter of Free Residual  $\text{Cl}_2$  (at tap)



## *Analyzing Free Residual Chlorine*



*Combined Residual + Free Residual = Total Residual*

## *Vector Control*

Reduce transmission of vector related diseases by directly or indirectly destroying the carriers (vectors).

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## *Vector Control Actions*

- Improve general sanitation (latrines, waste water, garbage, food & water storage, etc.)
- Personal Protection via education and behavior changes
- Environmental Modification
- Chemical Methods
- Medical Treatment

## Vector Control by Species

- Mosquito borne (malaria, elephantiasis)
- Fly borne (diarrhoeal, trachoma)
- Louse borne (typhus, relapsing fever)
- Tsetse borne diseases (trypanosomiasis)
- Bug-borne diseases (bedbugs)
- Black-fly borne diseases (onchocerciasis)
- Sandfly borne diseases (leishmaniasis)
- Mite borne diseases (scabies)
- Flea borne diseases (murine typhus, plague)
- Tick borne diseases (tularemia)
- Rodent borne diseases (lassa fever & reservoirs)

## *Planning: Words of Advice*

Water, sanitation and health education should always go together.

Always try to involve the refugees in all the planning, design, construction and maintenance of the program.

Think low tech, low cost, and use as many local materials as possible.



## *Planning: Words of Advice*

Continue to improve conditions

Do regular needs assessments :  
*Needs in emergency and post  
emergency are always evolving.*

Set up a surveillance system

## *Hygiene Promotion: Words of Advice*

*Hygiene promotion must be accompanied by material support*

*Promote clear, simple and memorable messages*

*Use local leaders and educators to get the message out*

## *Latrines: Words of Advice*

Start latrine construction project as quickly as possible

A family latrine is always better than a communal latrine

Having a latrine does not mean that people will use it

Work closely with the community health educators



## *Water: Words of Advice*

15 liters per person per day is the *minimum* standard - it is not the maximum

Lots of water of fair quality is more important than a small quantity of very pure water

Provide water as soon as possible (in the first day, not the first month)

Keep in mind future increase in demand

# *Questions...*



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