

NONPOTABLE GRAY WATER SYSTEMS

September 11th, 2012

Introduction

- Gray water reuse is a controversial subject that simultaneously generates strong support and strong opposition.
- The notion of using every drop of water to help alleviate the pressures on the already stressed water resources in Jordan is counteracted by environmental, health, and social concerns.
- Nevertheless, many success stories have been reported in Jordan.

Definition

- Gray water, is untreated waste water that has not come into contact with toilet waste, kitchen sink waste, dishwasher waste or similarly contaminated sources. Gray water includes waste water from bath-tubs, showers, bathrooms wash basins, clothes-washers and laundry tubs.
- Reclaimed Gray Water – Nonpotable Gray water that meets or as a result of treatment, meets national requirements for its intended uses.



The Controversy

- The controversy has its roots in the lack of proper regulations to control the gray water reuse. For example, the current standards; JS 1776:2008 entitled, "Reclaimed Gray Water in Rural Areas", allows an effluent standard for BOD_5 as high as to 300 mg/L, which is classified as a medium strong wastewater. Thus, discharging such effluent (graywater / wastewater) for irrigation directly violates Jordan Environment law No. 52 of the year 2006 which prevents discharging such effluent (wastewater) into the environment.

Summary of Previous Studies

- [Summary table](#)

4 Barrel Graywater Unit



RSS Storage Tank and Filter



Horizontal Gravel Filter



Constructed Wetland



German Hi-Tech Graywater System

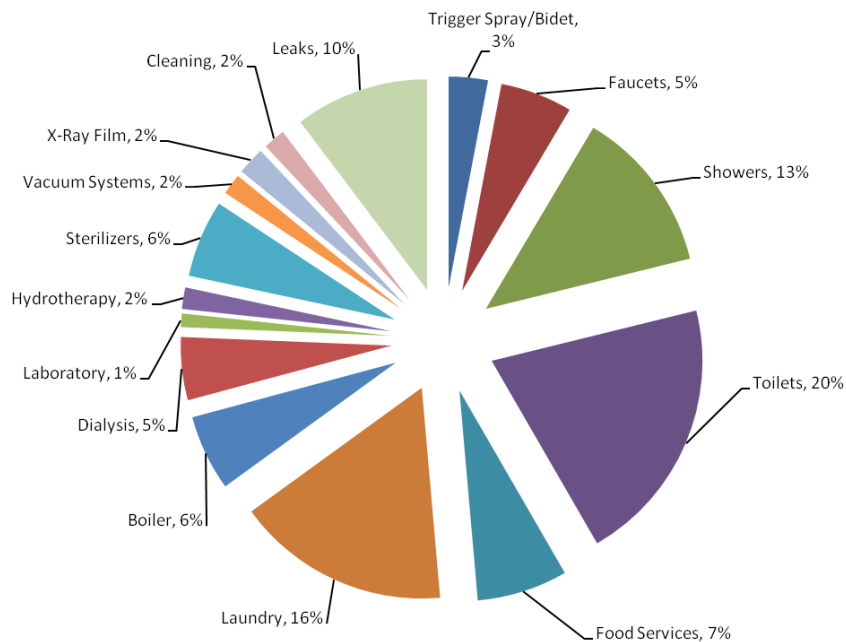


Estimating Graywater Quantities

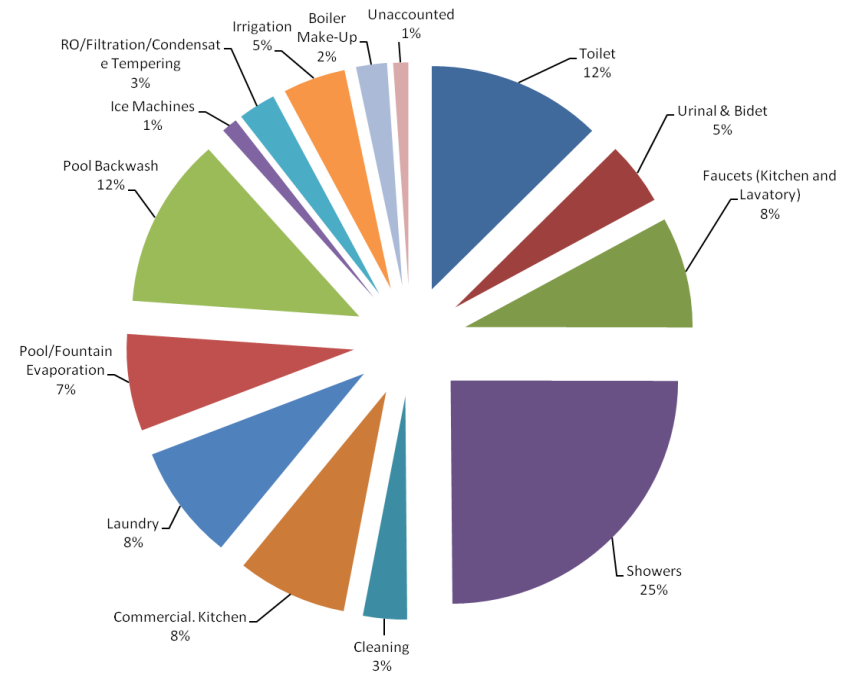
- **Water Use Profiles**

IDARA Findings

HOSPITAL WATER USE

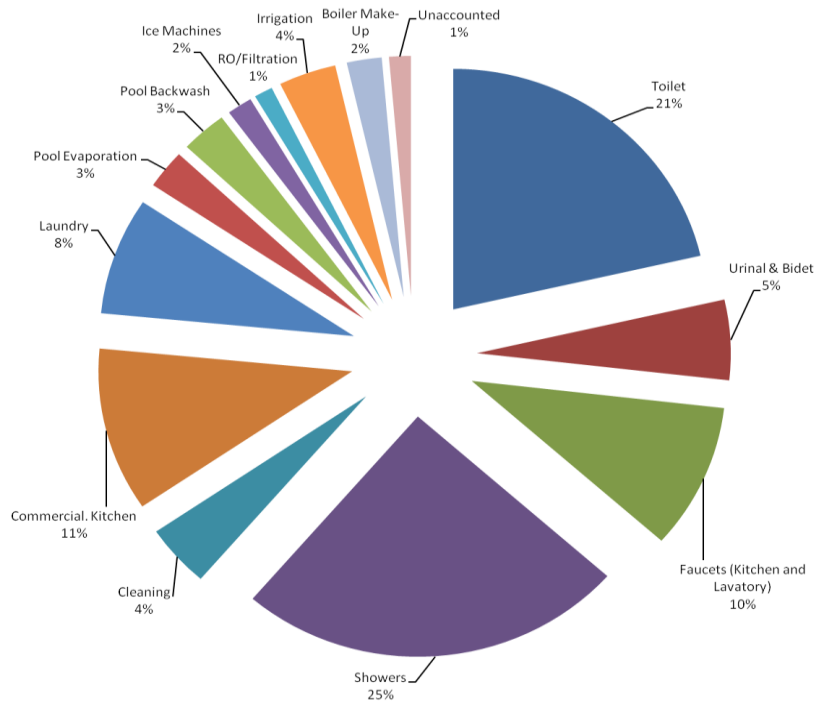


HOTELS WATER USE (5 STARS)

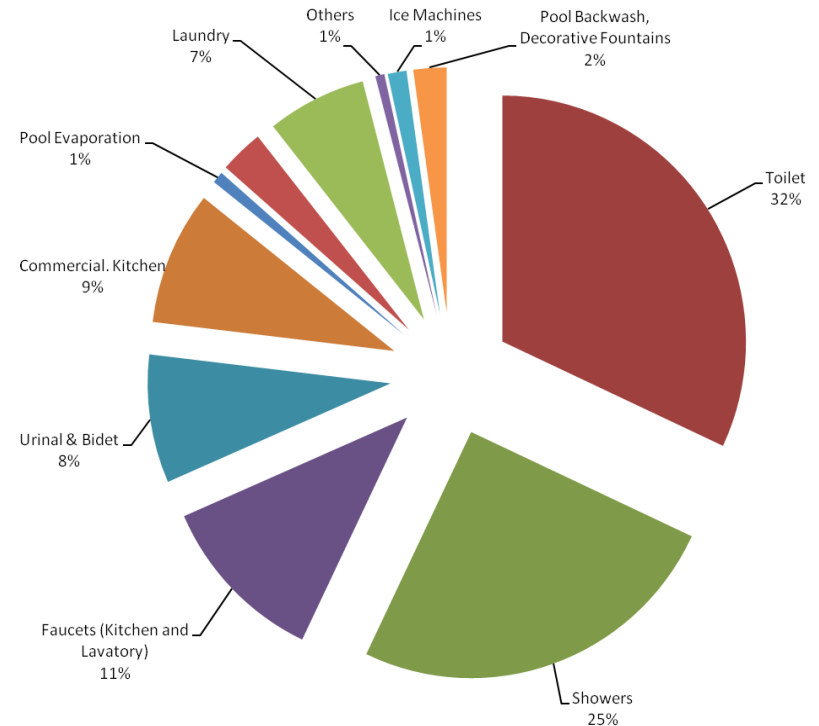


IDARA Findings

HOTELS WATER USE (4 STARS)

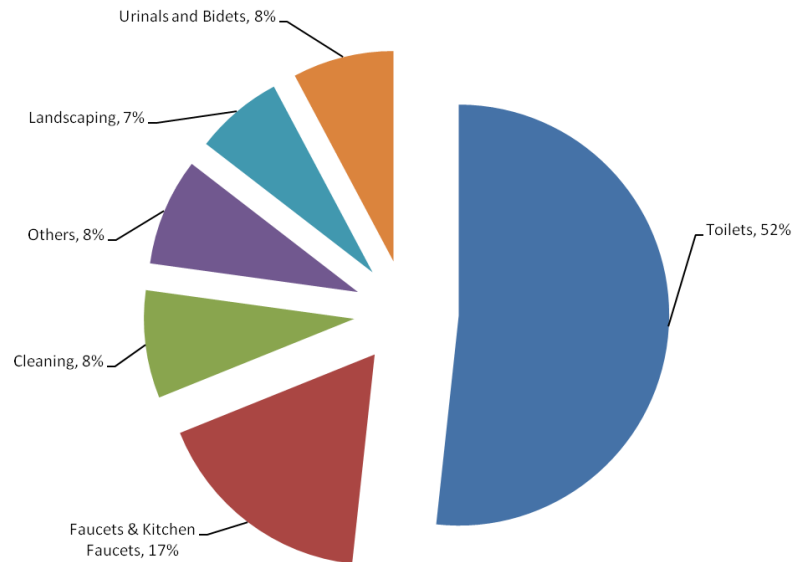


HOTELS WATER USE (2 & 3 STARS)

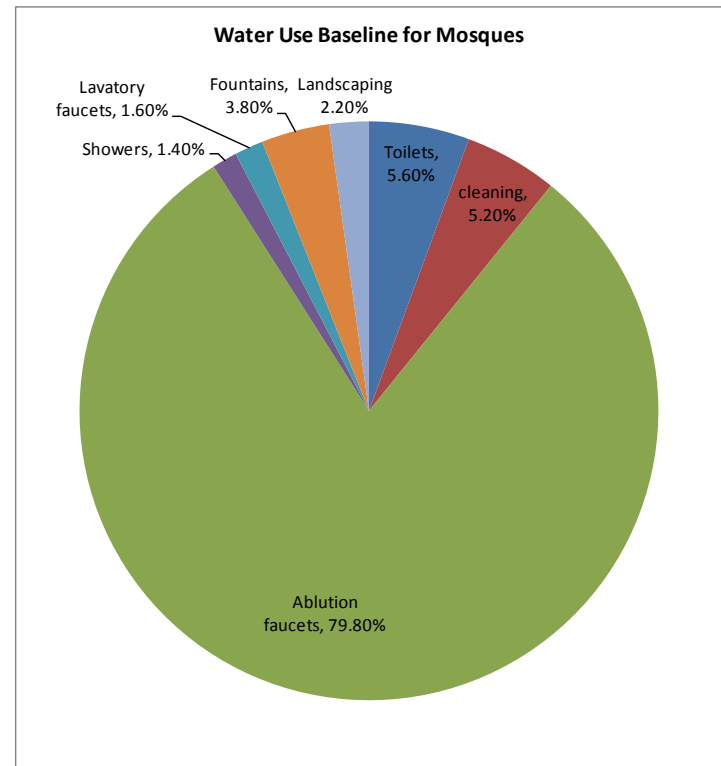


IDARA Findings

OFFICES WATER USE

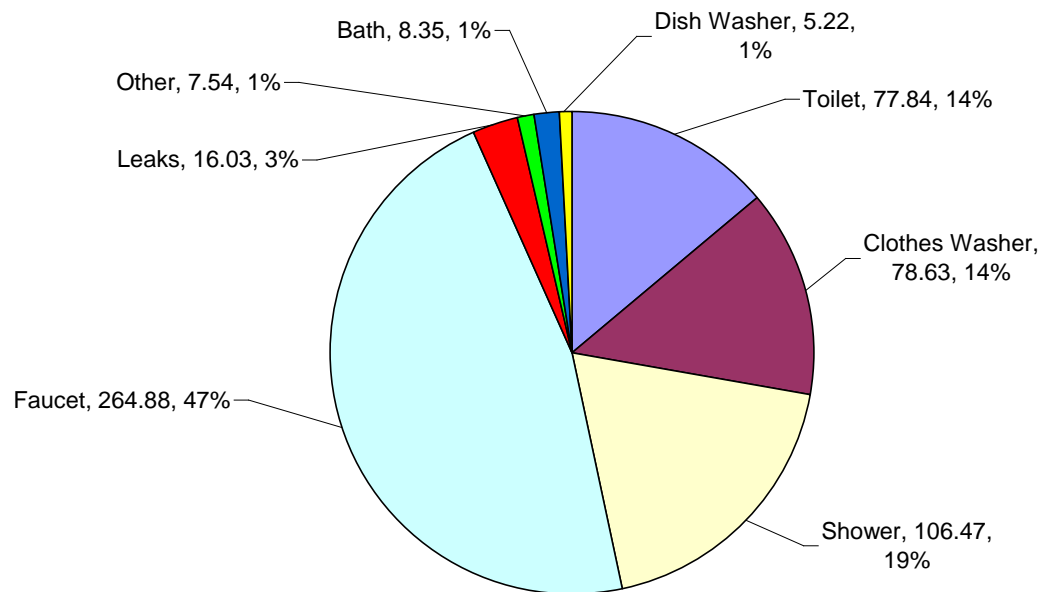


MOSQUES WATER USE



IDARA Findings

RESIDENTIAL WATER USE



Estimating Discharge

Calculation from currently recorded water use profiles for the different sectors

2-3 star hotels:

- Over all recorded water use: 5.1 cubic meter/day or (160 Liter/Guest/day)
- Average Water Use Profile: Toilets, 32%; Showers, 25%; Faucets (kitchen and lavatory), 11%; Urinal & Bidet, 8%; Commercial Kitchen, 9%; Pool evaporation, 1%; Laundry, 7%; Others, 1%; Ice machines, 1%; Pool backwash/ decorative fountains, 2%
- Potential Gray water percentage: Showers, 25% + Half the Faucets, $\frac{1}{2} * 11\%$ + Pool backwash and decorative fountains, 2% = 32.5%
- Potential Gray water quantities: **1.65 cubic meter /day**

Estimating Discharge

4 star hotels:

- Over all recorded water use: 18 cubic meter / day or 332 liter/Guest/day
- Average Water Use Profile: Toilets, 21%; Urinal & Bidet, 5%; Faucets (kitchen and lavatory), 10%; Showers, 25%; Cleaning, 4%; Commercial kitchen, 11%; Laundry, 8%; Pool evaporation, 3%; Pool backwash, 3%; Ice machines, 2%; RO/Filtration, 1%; Irrigation, 4%; Boiler/Make-up, 2%; Unaccounted, 1%
- Potential Gray water percentage: Showers, 25% + Half the Faucets (kitchen and lavatory), $\frac{1}{2} * 10\%$ + Pool Backwash, 3% = 33%
- Potential Gray water quantities: 6 cubic meter /day

Estimating Discharge

5 star hotels:

- Over all recorded water use: 80.5 cubic meter/day or 789 Liters/Guest/day
- Average Water Use Profile: Toilets, 12%; Urinal& Bidet, 5%; Faucets (Kitchen and lavatory), 8%; Showers, 8%; Cleaning, 3%; Commercial kitchen, 8%; Laundry, 8%; Pool/Fountain evaporation, 7%; Pool Backwash, 17%; Ice machines, 1%; RO/Filtration/Condensate tempering, 3%; Irrigation, 5%; Boiler make-up, 2%; Unaccounted, 1%
- Potential Gray water percentage: Showers, 8% + Half the Faucets (kitchen and lavatory), $\frac{1}{2} * 8\%$ + Pool Backwash, 17% = 29%
- Potential Gray water quantities: 23.3 cubic meters/day

Estimating Discharge

Hospitals:

Over all recorded water use: 208.3 cubic meter / day, or 916 Liter/ occupied bed/day

- Average Water Use Profile: Faucets, 5%; Showers, 13%; Cleaning, 2%; Food Services, 7%; Laundry, 16%; Boiler, 6%; Toilets, 20%; Trigger Spray/Bidet, 3%; Leaks, 10%; X-ray Film, 2%; Vacuum Systems 2%; Sterilizers, 6%; Hydrotherapy, 2%; Laboratory, 1%; Dialysis, 5%
- Potential Gray water percentage: Faucets, 5% + Showers, 13% = 18%
- Potential Gray water quantities: 37.5 cubic meter /day

Estimating Discharge

Offices:

- Over all recorded water use: 8.3 cubic meter / day, or 32 Liter/ employee/day
- Average Water Use Profile: Faucets and kitchen faucets, 17%; Cleaning, 8%; Toilets, 52%; Urinals and Bidets, 8%; Landscape, 7%; others, 8%
- Potential Gray water percentage: Faucets and kitchen faucets, 17%
- Potential Gray water quantities: 1.4 cubic meter /day

Estimating Discharge

Residential Buildings:

- Over all recorded water use: 0.55 cubic meter /day or 98 Liter/capita/day
- Average Water Use Profile: Faucet, 47% (an average of 30 Liters/day are used in the kitchen = 30.6%); Shower, 19%; clothes washer, 14%; Toilet 14%; Dish washer 1%; Bath 1%; Leaks 3%; and other 1%.
- Potential Gray water percentage: Faucet 16.4% + Shower 19% = 35.4%
- Potential Gray water quantities: 0.20 cubic meter/day

Estimating Discharge

Mosques:

- Over all recorded water use: 10 liters/person
- Average Water Use Profile: Toilets, 5.6%; Cleaning, 5.2%; Ablution faucets, 79.8%; Showers, 1.4%; Lavatory faucets, 1.6; fountains, 3.8%; Landscaping, 2.2%
- Potential Gray water percentage: Ablution faucets, 79.8% + Showers, 1.4% + Lavatory faucets, 1.6% = 82.8 %
- Potential Gray water quantities: **8.3 Liter/person**

Estimating Discharge

- Calculations based on daily gray water generation potential per person

- (A) Single Family Dwellings and Multi-Family Dwellings:
The total number of occupants shall be multiplied by the applicable estimated gray water discharge (35 Liter/day/occupant). If needed, the average family size in Jordan is approximately 5.3 persons.
- (B) **Daily Discharge:** Gray water systems shall be designed to distribute the total amount of estimated gray water on a daily basis.

Estimating Discharge

(C) Hotels, Hospitals, Office Buildings, and others:

- Hotels:
 - 2-3 star hotels: Gray water discharge: 52 Liter/Guest/day
 - 4 star hotels: Gray water discharge: 110 liter/Guest/day
 - 5 star hotels: Gray water discharge: 229 Liters/Guest/day
- Hospitals:
Gray water discharge: 165 Liter/ occupied bed/day
- Offices:
Gray water discharge: 5.5 Liter/ employee/day
- Residential Buildings:
Gray water discharge: 35 Liter/capita/day
- Mosques:
Gray water discharge: 8.3 liters / person

Provisions

- The code shall apply to the construction, alteration and repair of reclaimed gray water systems intended for all potential urban and rural uses.
- For all purposes, no direct use of gray water is allowed. A pretreatment scheme is required.
- Gray water installation shall be designed by a registered or licensed person and shall be installed by a person(s) with appropriate experience and training.

Treatment Units

- Treated gray water reuse with low risk of contact with users (e.g. subsurface irrigation ...) requires a primary treatment as a minimum.
- Treated gray water reuse with intermediate to high risk of contact with users (e.g. toilet flushing, drip irrigation, sprinkler irrigation ...) requires a secondary treatment followed by disinfection at a minimum.

Secondary Treatment

- Secondary treatment effluent concentrations are not to exceed 10 milligrams per liter for both five-day Biochemical Oxygen Demand (BOD₅) and total suspended solids (TSS).
- Disinfected gray water total coliform concentration is not to exceed a seven-day mean of 2.2 colony-forming units (CFU)/100 mL under a three-day/week monitoring frequency.

Provisions (cont.)

- The provisions of the Jordanian Code for Building Sanitation of the year 1988 and the Jordanian Code for Water Supply for Buildings of the year 2003 shall be applicable to gray water installation.
- No permit for any reclaimed gray water system shall be issued until complete plumbing plans, with appropriate data satisfactory to the Authority Having Jurisdiction, have been submitted and approved.

Provisions (cont.)

- No changes or connections shall be made to either the reclaimed gray water system or the potable water system without approval by the Authority Having Jurisdiction.
- Initial cross-connection test in the presence of the Authority Having Jurisdiction is required
- No gray water system or part thereof shall be located on any lot other than the lot that is the site of the building or structure that discharges the gray water.

Provisions (cont.)

- No permit shall be issued for a gray water system for irrigation purposes on any property in a geologically sensitive area
- The capacity of the private sewage disposal system shall not be decreased or otherwise affected by the existence or proposed installation of a gray water system servicing the premises
- Long terms impacts of the reclaimed Gray water use on health, soil salinity, groundwater, and the social environment has to be considered before installation.

Provisions (cont.)

- The use of gray water systems should not cause a significant reduction in wastewater discharge to the point that it affects the flow of waste water in the public sewage network or the waste water treatment efficiency.
- The reduction in the total quantity of wastewater reaching the treatment facilities should not jeopardize current or future financial settings between the relevant water authority and the wastewater treatment plant operators or end users.
- Authority Having Jurisdiction may vary according to sector, application, and or location.

Provisions (cont.)

- It is highly recommended to conduct a comparative assessment of the gray water system under consideration with other water efficiency measures in particular the usage of water saving devices.



Inspection and Testing

- Inspection

- Reclaimed gray water piping shall be inspected and tested using the same provisions applicable to testing of potable water piping
- An initial and subsequent annual inspection and test shall be performed on both the potable and reclaimed gray water systems
- The potable and reclaimed gray water system shall be isolated from each other and independently inspected and tested to ensure there is no cross-connection

Inspection and Testing

- Inspection (cont.)
- Holding tanks, whenever applicable, shall be installed on dry, level, well-compacted soil if underground, or on a level (3) inch (76mm) concrete slab if above ground.
- Holding tanks, whenever applicable, shall be anchored against overturning.
- If a design is predicted on soil tests, the irrigation/disposal field shall be installed at the same location and depth as the tested area.
- Installation shall conform with equipment and installation methods identified in the approved plans.

Inspection and Testing

■ Testing

1. **Cross-Connection Test**

Reclaimed gray water system shall remain pressurized for a minimum period of time while the potable water system is empty. The drain on the potable water system shall be checked for flow during the test and at the end of the period.

2. **Dye or tracer Test**

Food dye is used to detect any cross-connection

Pipe Material

- Reclaimed gray water pipe, valves and fittings shall conform to the requirements for potable water outlined in the Jordanian Code for Water Supply for Buildings of the year 2003, Section 2/3 or the requirements of any recent updates.

Pipe Color

- Reclaimed gray water systems shall have a purple background with black uppercase lettering with the words

“CAUTION: RECLAIMED GRAY WATER, DO NOT DRINK”.

Installation

- Hose bibs shall not be allowed on reclaimed gray water piping systems within the buildings and may be allowed outside when used for irrigation purposes.
- The reclaimed gray water system and the potable water system within the building shall be provided with the required appurtenances to allow for deactivation or drainage whenever needed.
- It is recommended that reclaimed gray water pipes shall not be run or laid in the same trench as potable water pipes



Signs

- Usage of grey water must be identified at all times with sentences such :
**TO CONSERVE WATER, THIS BUILDING USES
GRAY RECLAIMED GRAY WATER FLUSH TOILETS
AND UNIRALS.**



Size

Reclaimed gray water piping shall be sized as outlined in this code for sizing potable water piping.



Stakeholder Engagement

- A wide range of view points highlighting: special interest groups for reusing graywater tailoring the code to suite their needs
- Groups and individuals against Graywater reuse due to health, religious, financial ... reasons.

Status

- Use of Non potable Graywater Systems is optional and the developed chapter will be the guide for potential users.

Thank You

Thank You