Sustainable Water Systems in Buildings

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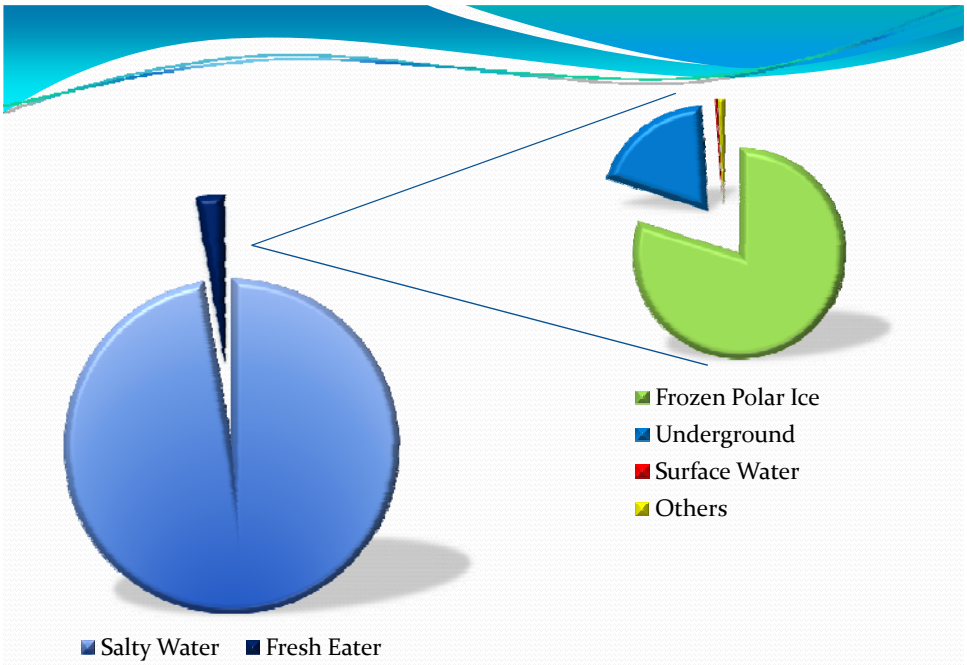
- World tallest structure
- 12,000 occupants
- **500 million** gallon of water / year
  - From where ?
  - Going where ?
- A/C condenses **15 million** gallon of water / year

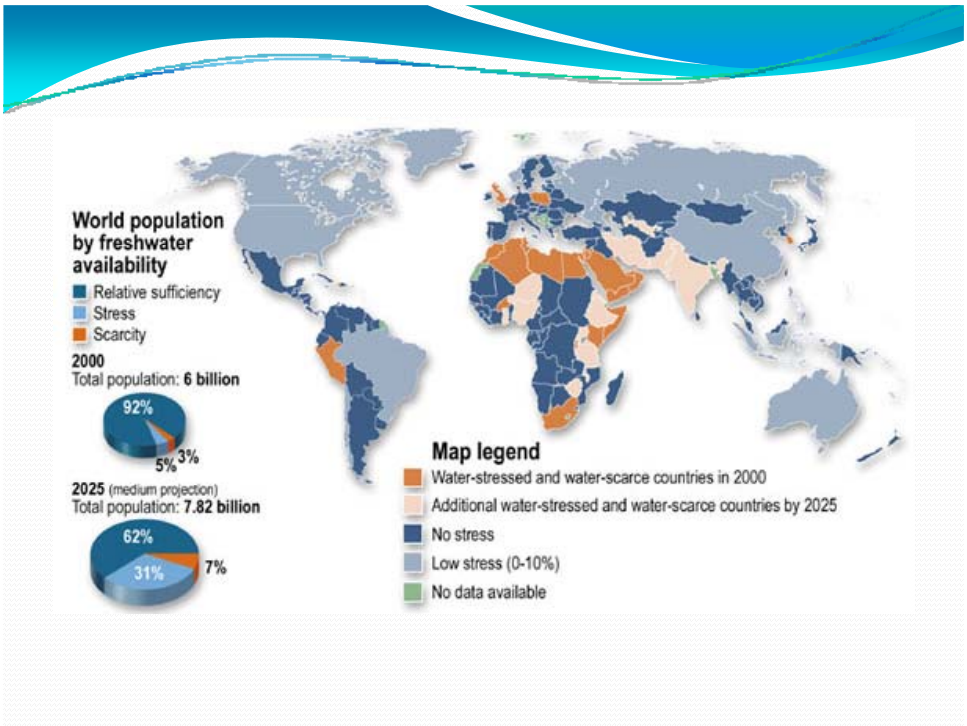
Agenda

- Water in the Environment
- Water Issue in Buildings
- Water Use in Buildings
- Sources of Water for Buildings
- Strategies for Sustainable Water Systems
- Training Exercise

Water in the Environment



Surface Water is not Evenly Distributed



Water Issue in Buildings

Is there a regional effect?

Impeded Water Consumption

Source: Water Footprint Network http://www.waterfootprint.org

One cup of coffee requires**140 liter** of water

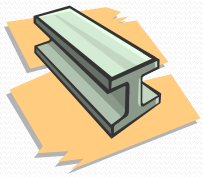
One liter of milk requires **1,000 liter** of water

One Kg of beef requires**16,000 liter** of water

Impeded Water Consumption

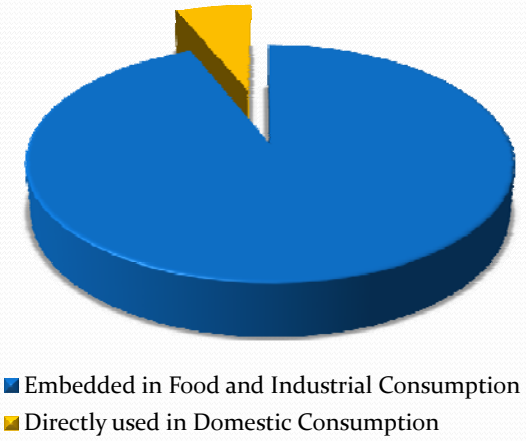
Source: Environment Canada - water Quick Facts

One Kg of paper requires **300 liter** of water



One Ton of steel requires **215,000 liter** of water

Human Consumption of Water



Issue of Water Quality

- The main problem for domestic water is the quality of water .
- **High quality** water need to be provided
  - Requires infrastructure for :
    - treatment
    - supply network
- **Dangerous** waste water need to be dealt with
  - Requires infrastructure for :
    - transportation
    - treatment

Enormous Cost

Cost of supplying and draining domestic water

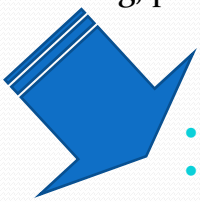
- Abu Dhabi **desalination plant** at Umm Al Nar
  Dh 7.5 billion (2003 data)

- Jebel Ali **sewage treatment plant**
  Dh 1.56 billion (2005 data)

- Sharjah **drainage network**
  Dh 3.00 billion (2010 estim.)

Objective of Sustainable Water Systems in Buildings

- Minimize the need to treat, transport and supply buildings with water , particularly from outside the project site.
- Minimize the need to transport and treat the water drained from the building, particularly to outside the project site.



- Less **water** is needed
- Less **material** is needed
- Less **energy** is needed
- Less **disruption** to nature

Water Use in Buildings

Cleansing and Hygiene

Major consumer ?

Moving Organic Waste

Major consumer ?

Ceremonial

Major consumer ?

Ornamental use

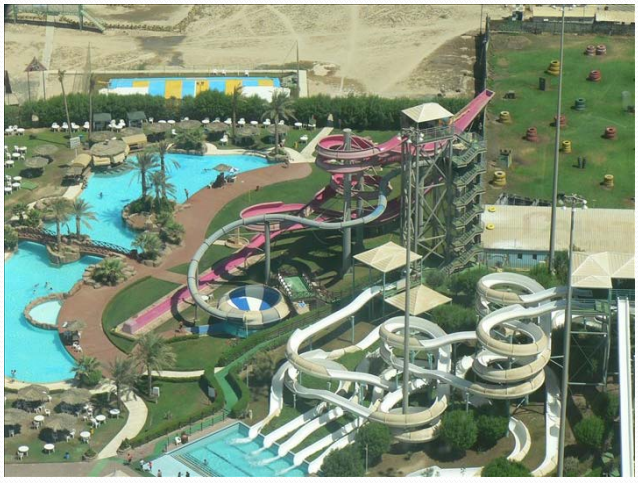
Major consumer ?

Landscaping

Major consumer ?

Leisure Use

Major consumer ?



Heating and Cooling

Major consumer ?

Fire Fighting

Major consumer ?

Defense and Security

Major consumer ?

During Construction

Major consumer ?

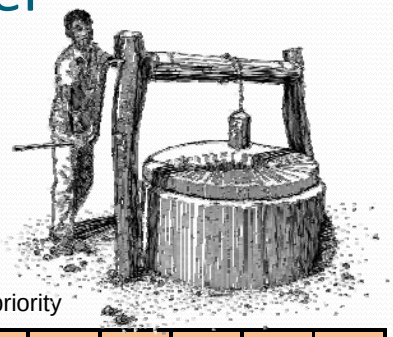
Sources of water for buildings

Municipal water system

(X) Do not use
(/) Can be used
(//) Can be used and should be given priority

	Moving organic waste	Cleansing and hygiene	Ceremonial	Ornamental use	Leisure use	Heating and cooling	Fire fighting	Defense and security	Landscaping
Municipal water system	/	/	/	/	/	/	/	/	/

Underground water



(X) Do not use
(/) Can be used
(//) Can be used and should be given priority

	Moving organic waste	Cleansing and hygiene	Ceremonial	Ornamental use	Leisure use	Heating and cooling	Fire fighting	Defense and security	Landscaping
Underground water	/	/	/	/	/	/	/	/	/

Rain water

(X) Do not use
(/) Can be used
(//) Can be used and should be given priority

	Moving organic waste	Cleansing and hygiene	Ceremonial	Ornamental use	Leisure use	Heating and cooling	Fire fighting	Defense and security	Landscaping
Rain water *(filtered)*	//	X	X	//	X	//	/	//	//

Grey water

(X) Do not use
(/) Can be used
(//) Can be used and should be given priority

	Moving organic waste	Cleansing and hygiene	Ceremonial	Ornamental use	Leisure use	Heating and cooling	Fire fighting	Defense and security	Landscaping
Grey water *(treated)*	//	X	X	X	X	X	X	X	//

Black water

(X) Do not use
(/) Can be used
(//) Can be used and should be given priority

	Moving organic waste	Cleansing and hygiene	Ceremonial	Ornamental use	Leisure use	Heating and cooling	Fire fighting	Defense and security	Landscaping
Black water *(treated)*	//	X	X	X	X	X	X	X	//

Water vapor in the air

(X) Do not use
(/) Can be used
(//) Can be used and should be given priority

	Moving organic waste	Cleansing and hygiene	Ceremonial	Ornamental use	Leisure use	Heating and cooling	Fire fighting	Defense and security	Landscaping
Water vapor in the air	//	X	X	//	X	//	/	//	//

Desalinated water

(X) Do not use
(/) Can be used
(//) Can be used and should be given priority

	Moving organic waste	Cleansing and hygiene	Ceremonial	Ornamental use	Leisure use	Heating and cooling	Fire fighting	Defense and security	Landscaping
Desalinated water	/	/	/	/	/	/	/	/	/

Sea water

(X) Do not use
(/) Can be used
(//) Can be used and should be given priority

	Moving organic waste	Cleansing and hygiene	Ceremonial	Ornamental use	Leisure use	Heating and cooling	Fire fighting	Defense and security	Landscaping
Sea water	/	X	X	X	X	X	X	//	X

Strategies for Sustainable Water Systems

Five Main Strategies

1. Reduce water demand in the project
2. Optimize design
3. Optimize operation
4. Minimize acquired water
5. Minimize released water

Strategy # 1

Reduce water demand in the project

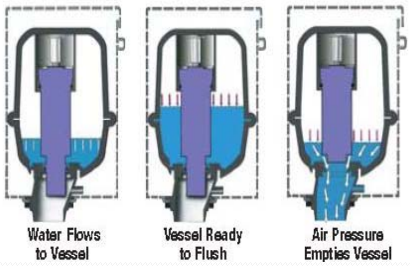
Toilets

- Low flow toilets
  - *Dual flush system*
  - *Pressurized air flushing*
  - *Flapperless toilet*
  - *Vacuum*
- Waterless toilets
  - *Composting toilets*
  - *Foam-flushed*
  - *Incinerating Toilets*

Dual flush system

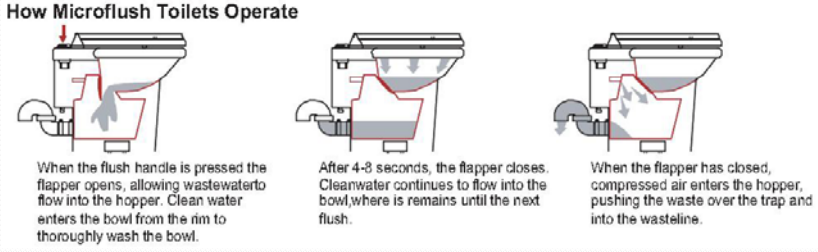
Pressurized air flushing

- Uses the pressure of the water supply to pressurize the air inside a tank
- Pressurized air in the tank significantly increase the water flow upon flushing
- Uses as low as **1.0 gallon** of water / flush.



Pressurized air flushing

- Air is pressurized with a pump
- Two stage process where waste move first from the bowl to another chamber in which the pressurized air is used to push the waste to the sewage system
- Has no tank
- 0.25 gallons of water is used per flush

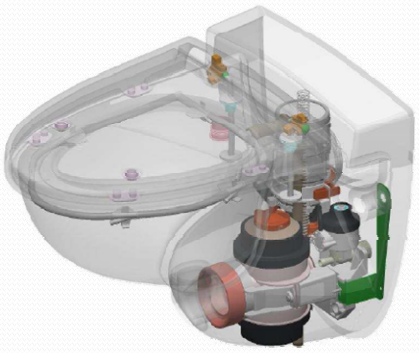


Flapperless toilet

- A bucket filled with water is kept horizontally near the top of the tank
- At the time of flushing, the bucket is turned to empty the reserved water
- Makes the potential for leaks much smaller.

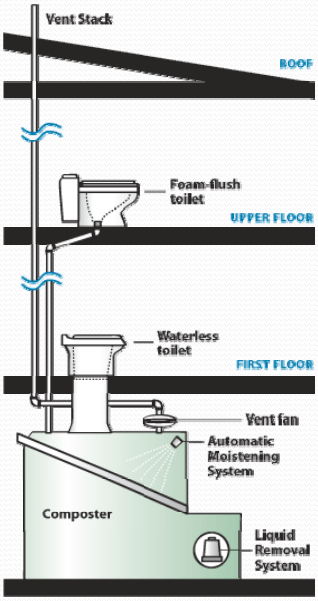
Vacuum

- Similar to airplane toilets.
- Require machines
- Enable installing pipes at any direction
- o.6 gallons / flush



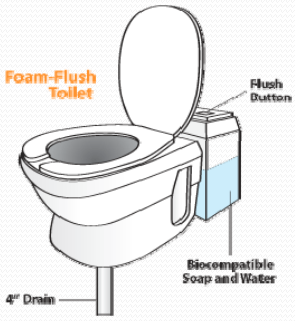
Composting toilets

- No water is used



Foam-flushed

- Used with composting toilets where a very small amount of water (3 ounces) is mixed with special soap to flush the toilet

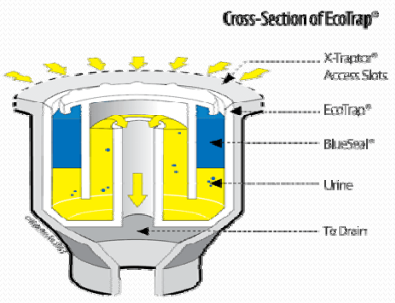


Incinerating Toilets

- Burn the human waste converting it to water vapor and ash.
- The burning occurs in a closed chamber and is done using an electric element or fired gas.

Shower heads

Waterless Urinals



Faucets

- Double handle
- Single handle
- Metered self closing
- Infrared
- Digitally controlled

Double Handle Faucet

Single Handle Faucet

Metered Self-Closing Faucet

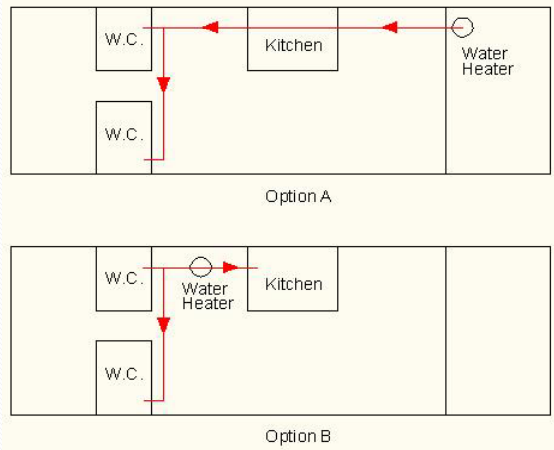
Infrared Faucet

Digitally Controlled Faucet

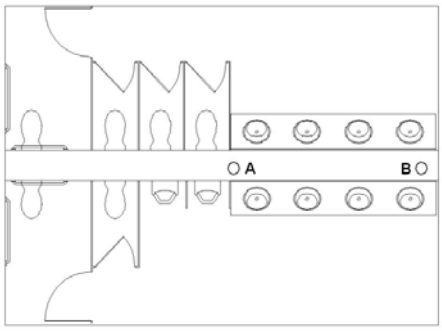
Strategy # 2

Optimize the design

Which option saves water and energy?



Which option saves materials?



Strategy # 3

Optimize operation

Methods to optimize operation

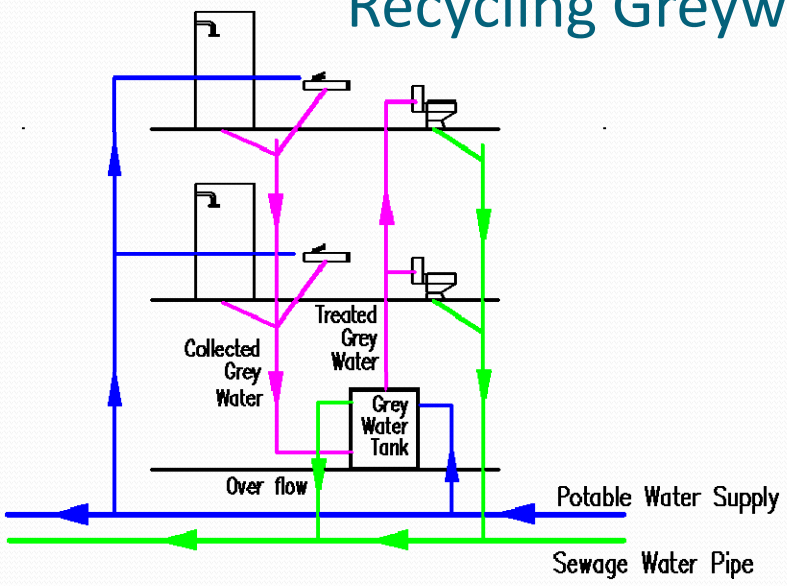
- Educate users and technicians
- Introduce regulations and penalties for improper use
- Eliminate leaks
- Monitor consumption pattern

Strategy # 4

Minimize acquired water

- Recycling greywater
- Recycling blackwater
- Capturing rain water
- Capturing water vapor in the air

Recycling Greywater



Recycling Blackwater

- ??????????????????

Capturing Rain Water

Capturing Water Vapor in the Air

- ??????????????????

Strategy # 5

Minimize released water

Waste water

- Private Septic System

Waste water

- Living Machines®

Storm water

- Pervious surfaces

Storm water

- Bioswales

Storm water

- Retention ponds