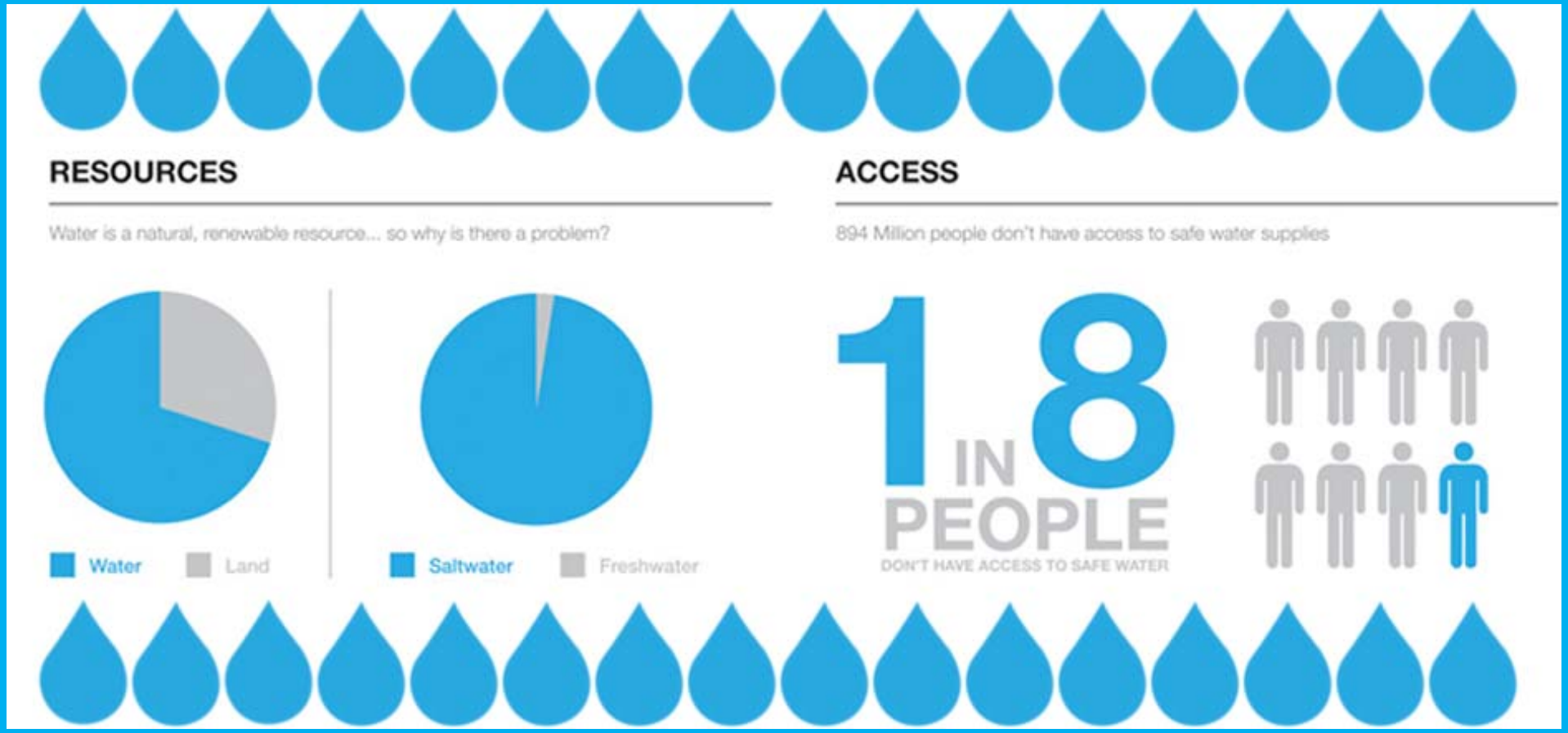
Water Issues in Buildings

Towards Reducing the Waste of Water by Architectural Design

Access to fresh, potable water throughout the world is not guaranteed.

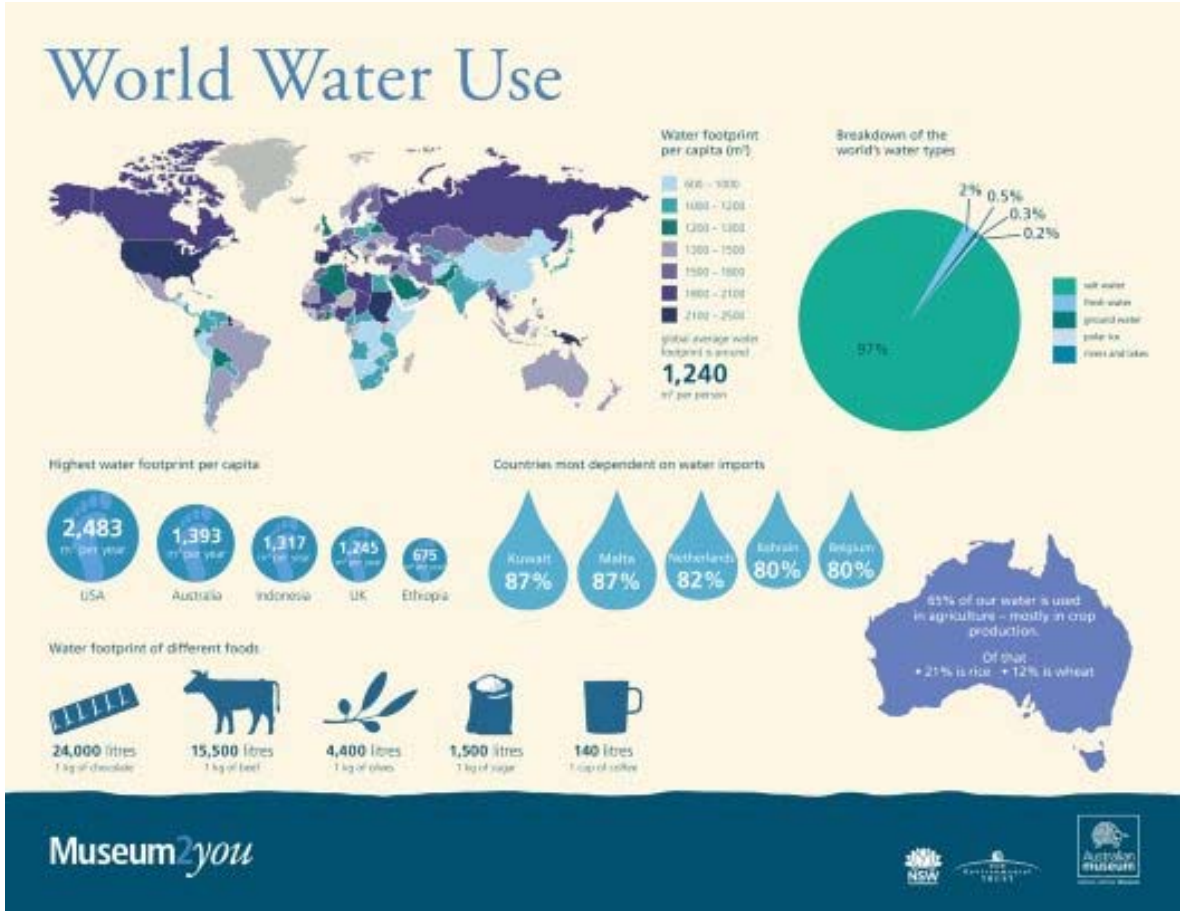


The abundance of fresh water in Canada has led us to a complacent state – actually, quite wasteful.

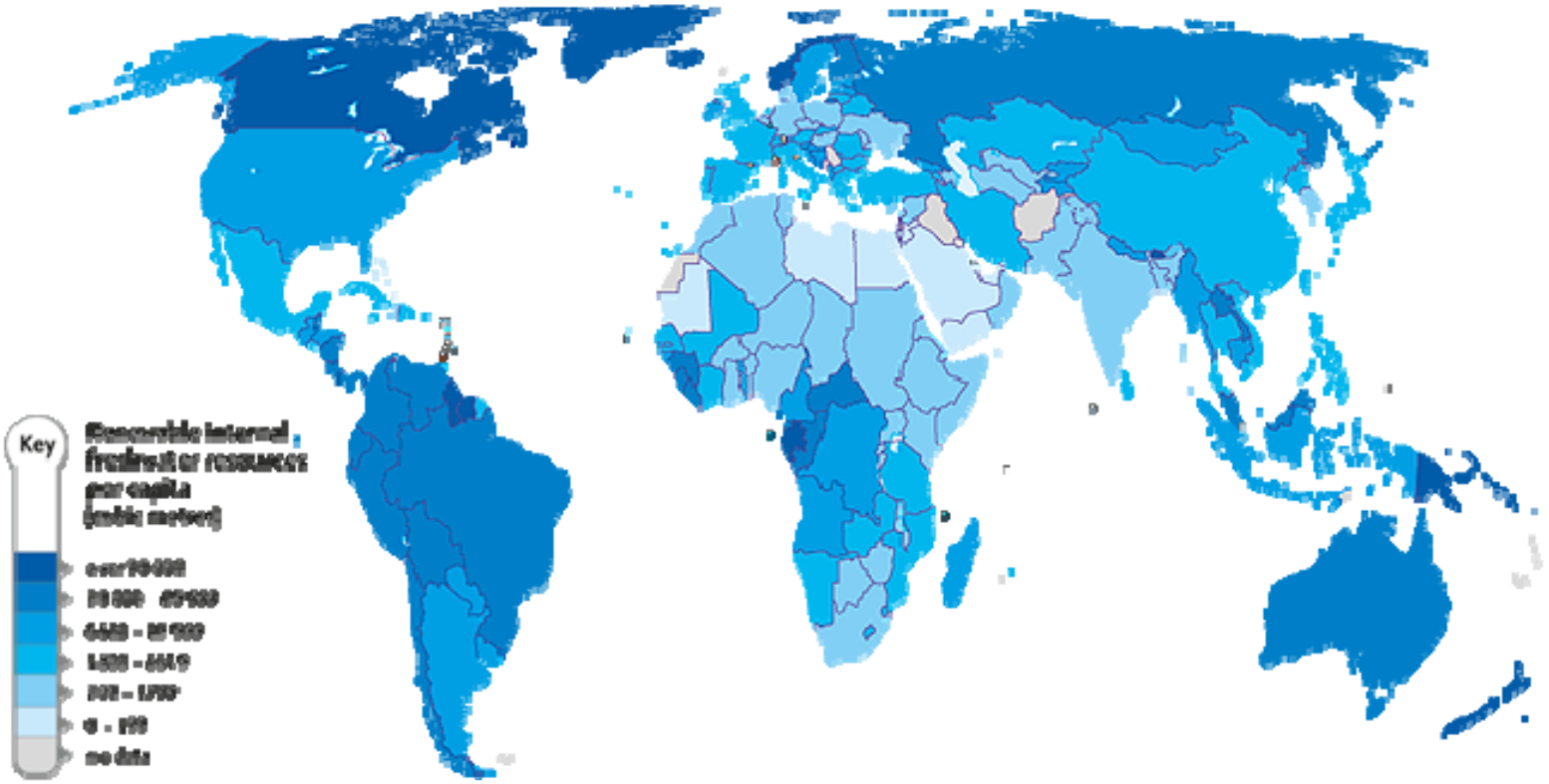
Global Water Crisis

Desalination is an extremely energy intensive proposition to address water shortages.

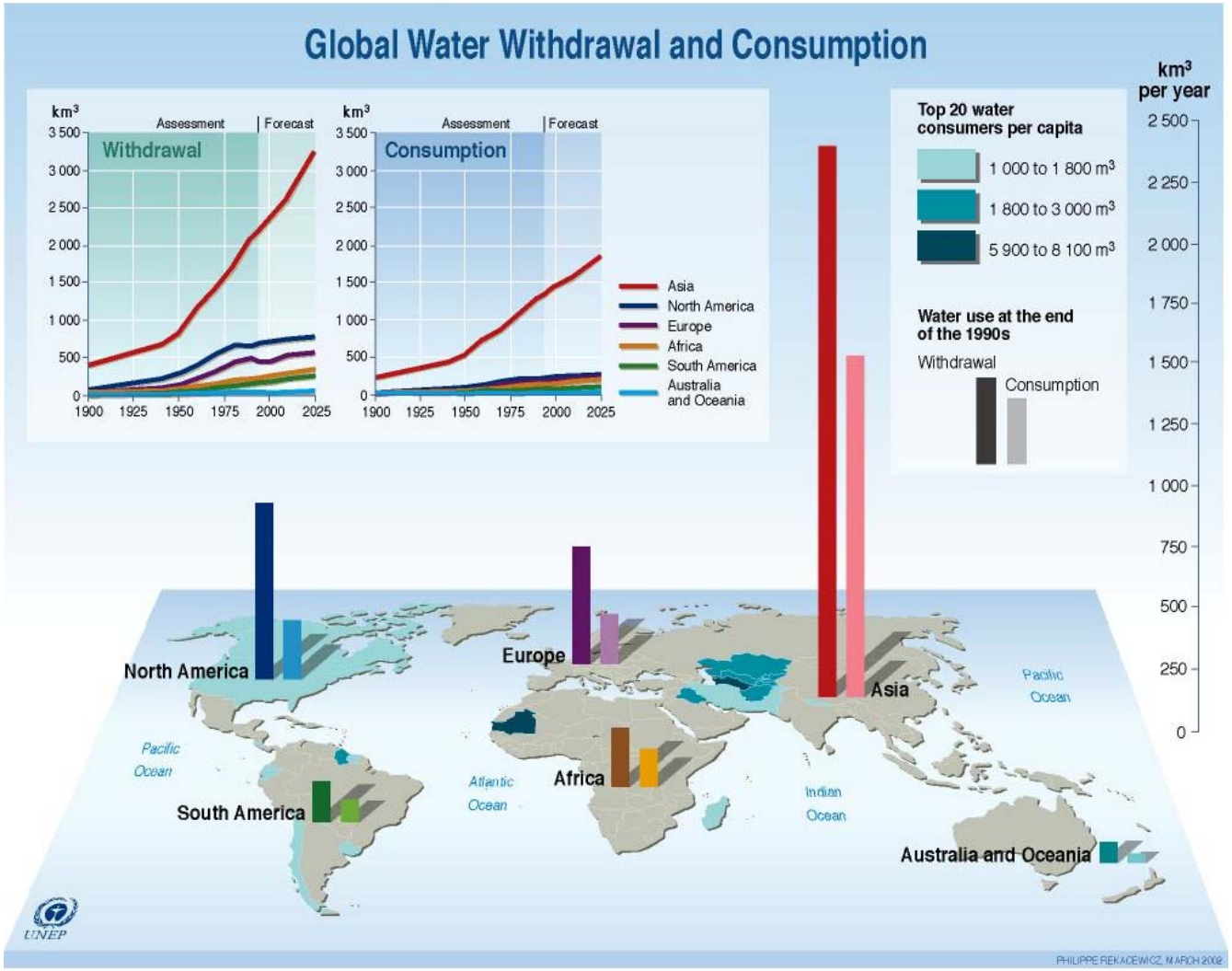
World Water Use



Countries with Fresh Water



Water Withdrawal & Consumption

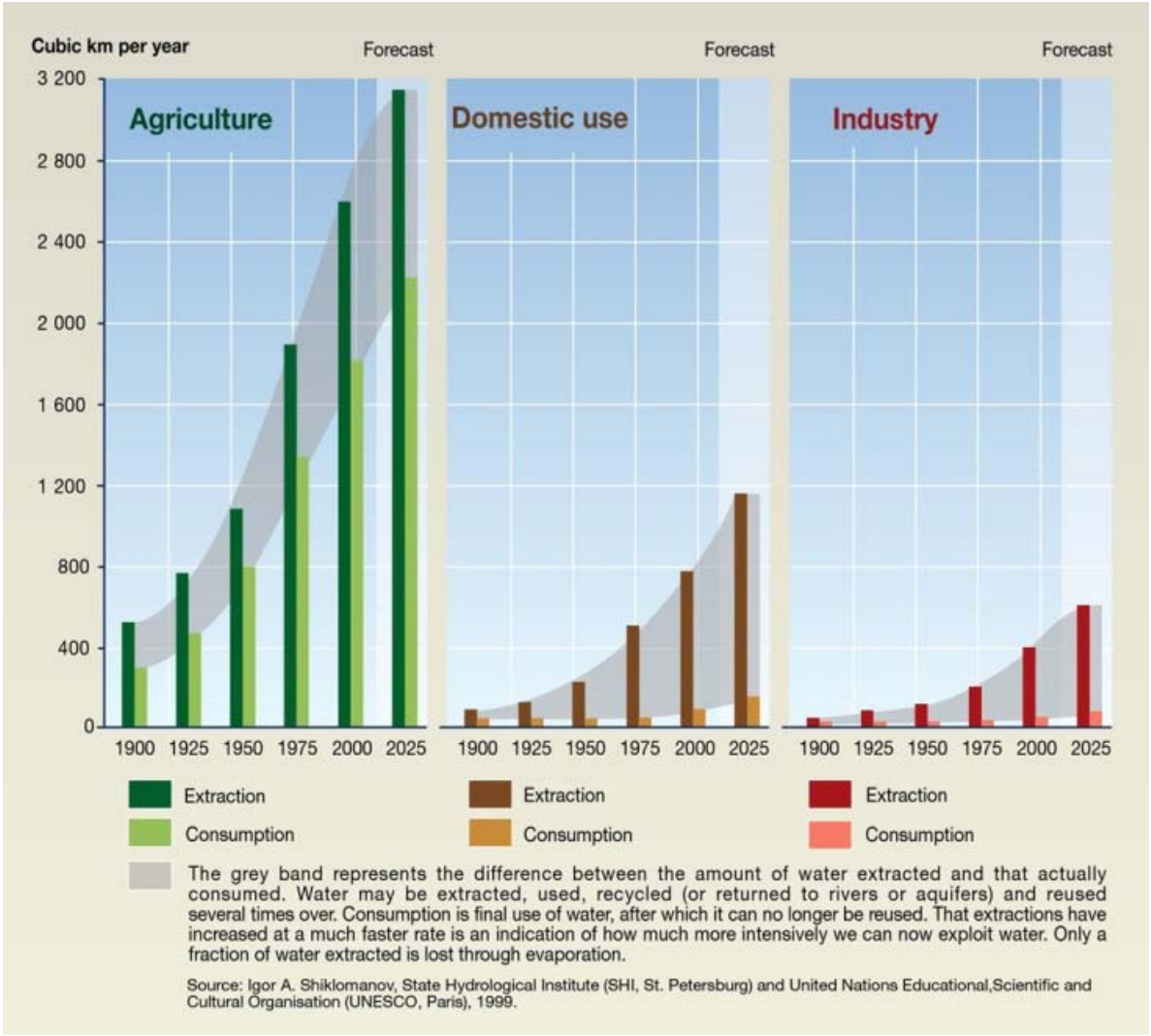


Source: Igor A. Shiklomanov, State Hydrological Institute (SHI, St. Petersburg) and United Nations Educational,Scientific and Cultural Organisation (UNESCO, Paris), 1999; *World Resources 2000-2001, People and Ecosystems: The Fraying Web of Life*, World Resources Institute (WRI), Washington DC, 2000; Paul Harrison and Fred Pearce, *AAAS Atlas of Population 2001*, American Association for the Advancement of Science, University of California Press, Berkeley.

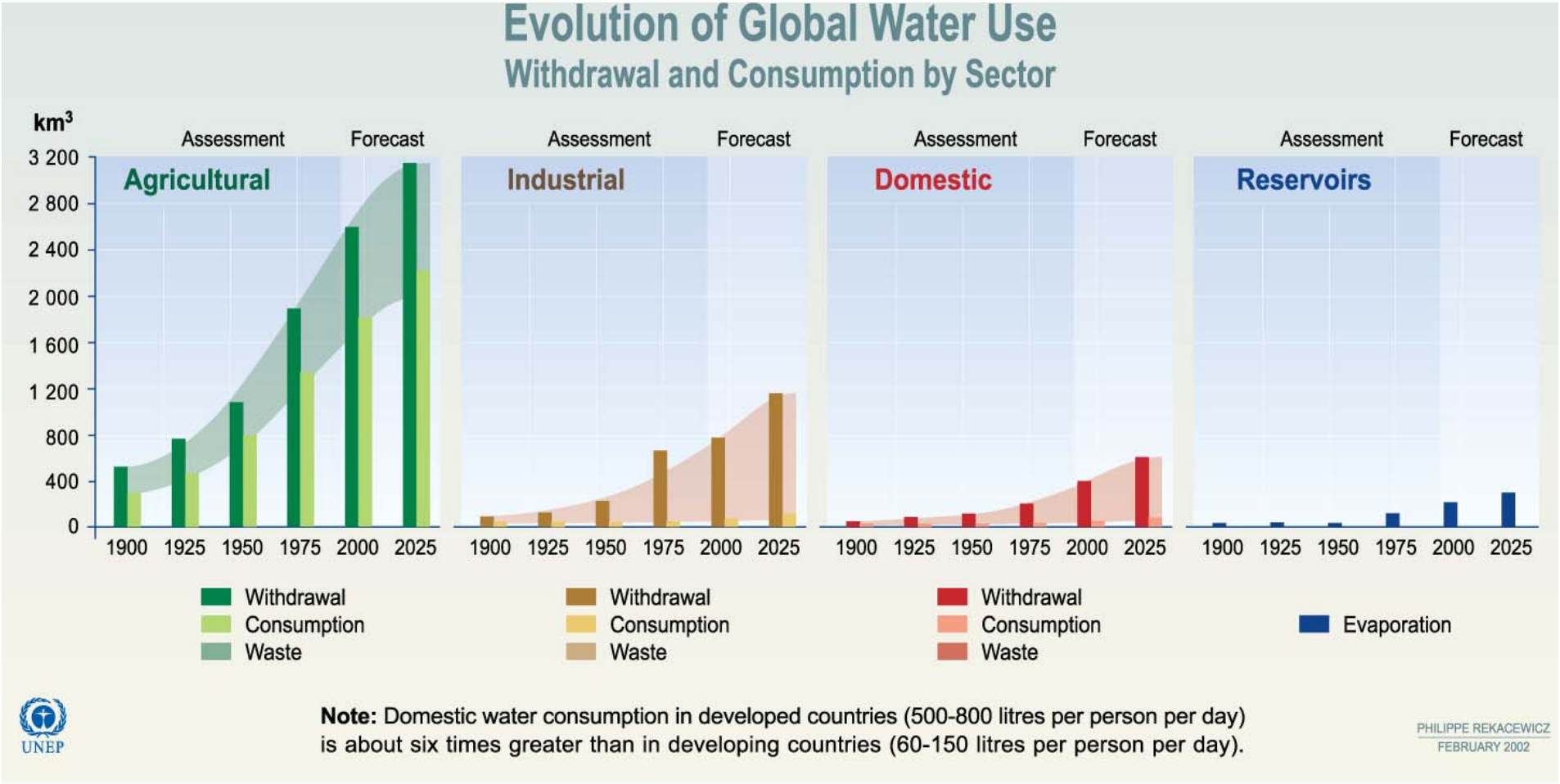
Water Crisis in the SouthWest US

The water level in Lake Mead (outside of Las Vegas) has dropped radically. Global warming, lack of winter snow melt and withdrawals further up river leave the reservoir short.

Water Use by Sector

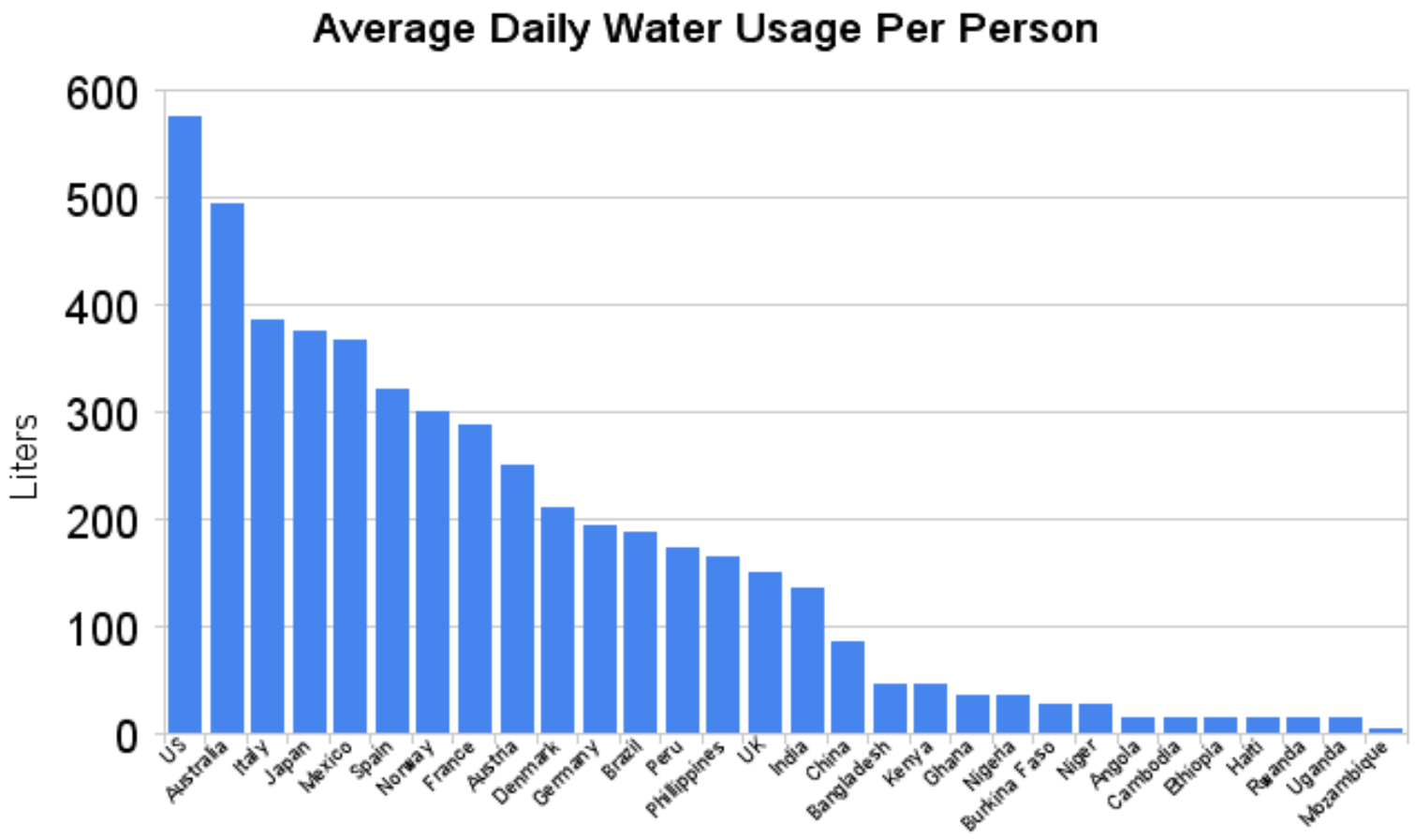


Evolution of Global Water Use

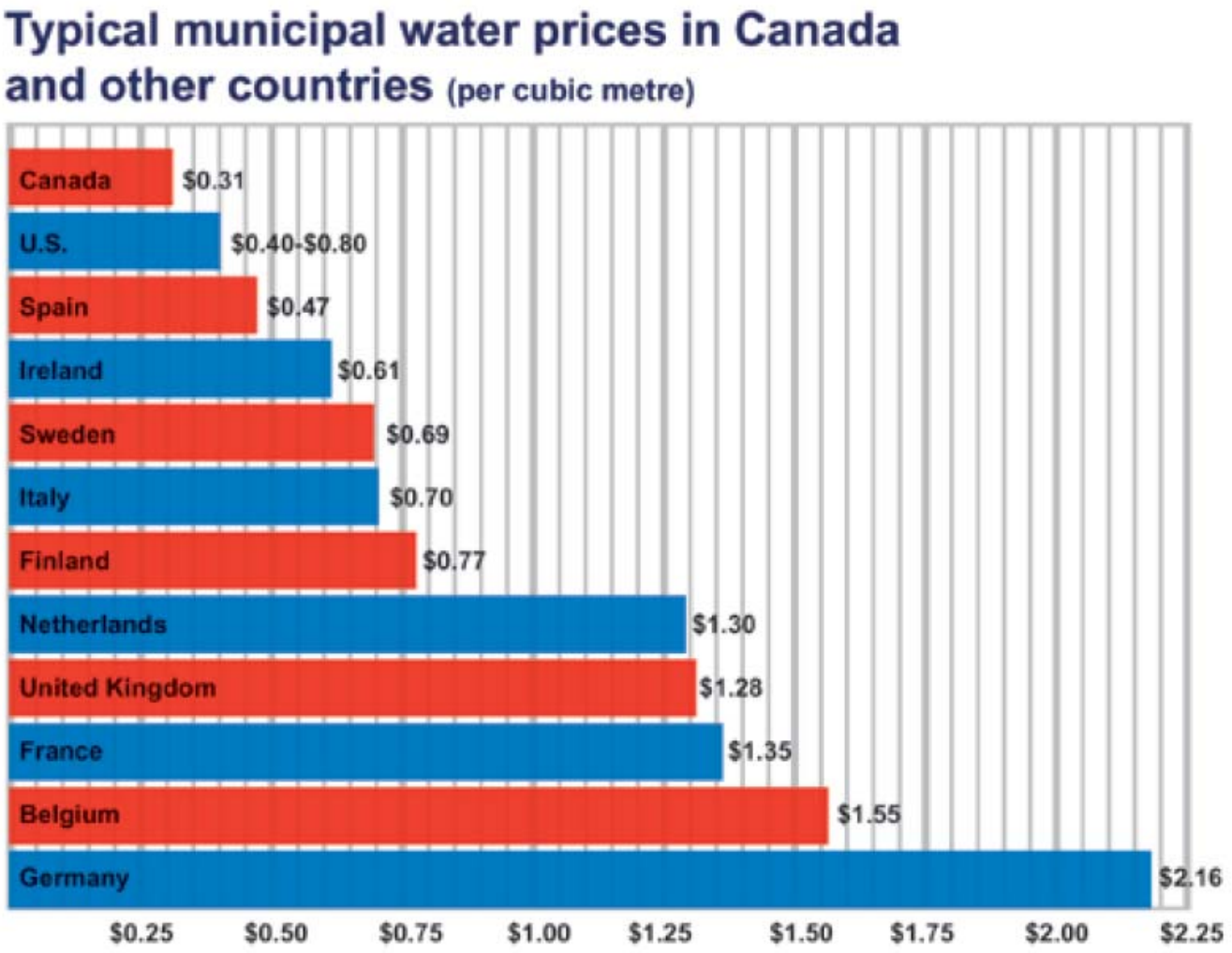


Source: Igor A. Shiklomanov, State Hydrological Institute (SHI, St. Petersburg) and United Nations Educational,Scientific and Cultural Organisation (UNESCO, Paris), 1999.

Average Daily Use per Person

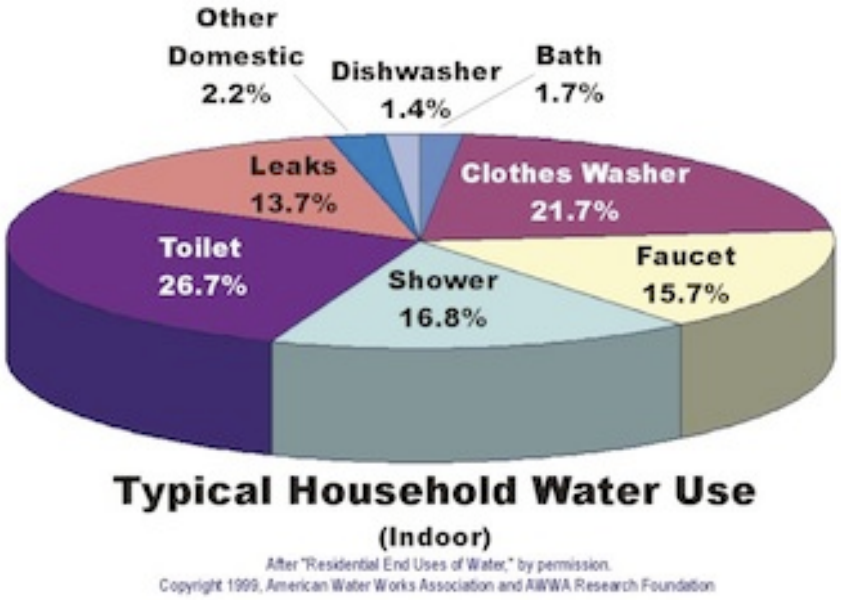


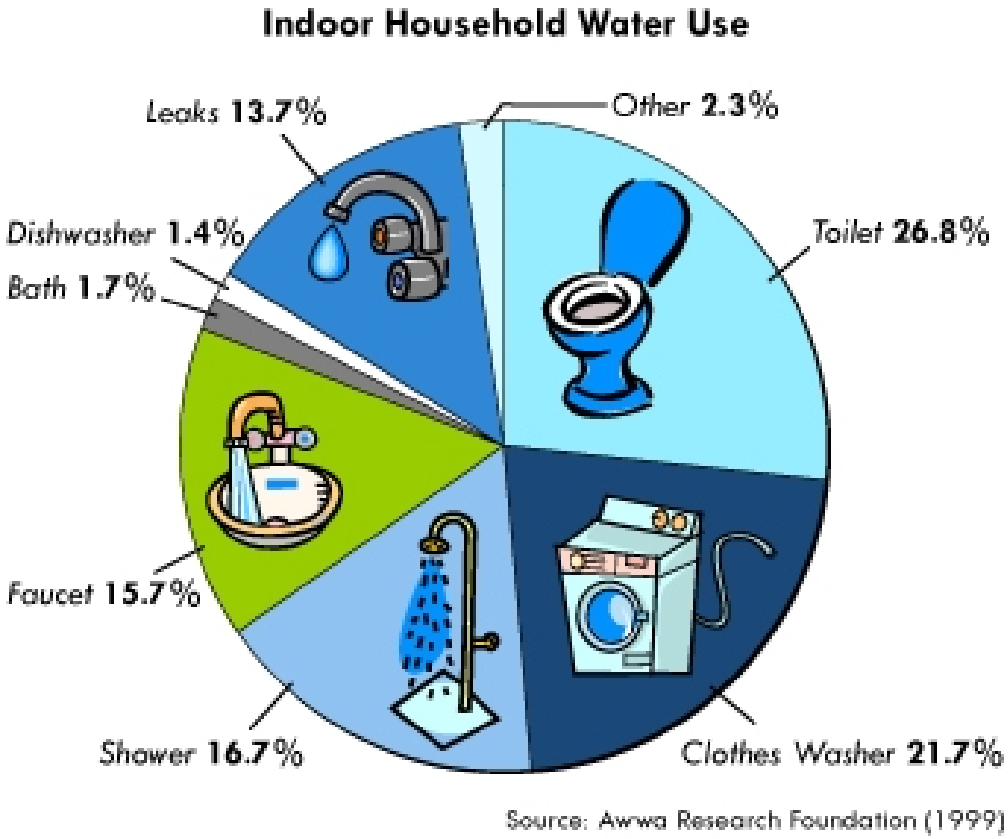
Water Prices



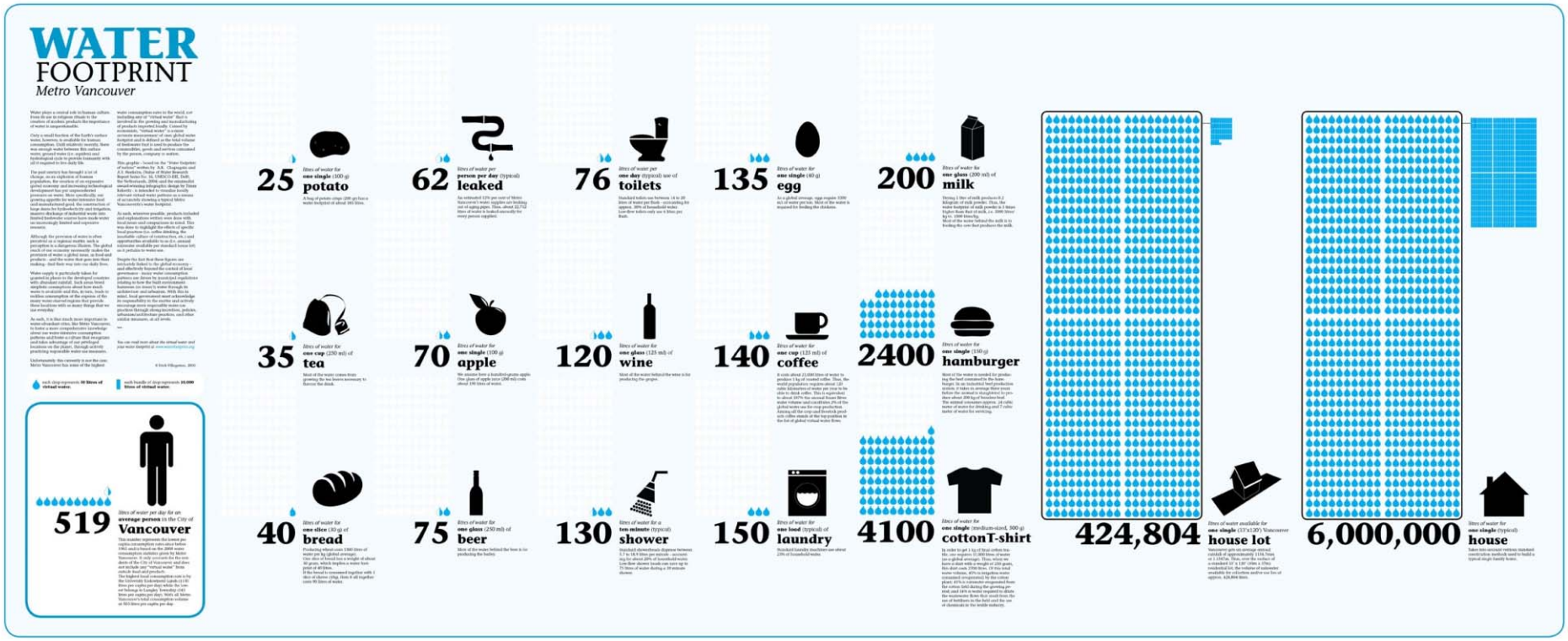
Comparative World Water Use

North American Household Water Use





Water Footprint (Vancouver)



Toronto Domestic Water Use

Indoor Water Use Breakdown					
Average Canadian Inhabitant Water usage				248	LPCD
	Percent	LPCD		Percent	LPCD
Toilet	28%	69.44	Leaks	11%	27.28
Clothes Washer	22%	54.56	Baths	3%	7.44
Shower	19%	47.12	Dishwasher	2%	4.96
Faucet	15%	37.20			
Reference: City of Toronto Wet Weather Flow Master Plan					

Walk This Way: Making the right choices to reduce your water footprint

= 1 GALLON **DIRECT USE:** THE WATER THAT YOU ACTUALLY USE.

= 1 GALLON **VIRTUAL USE:** THE WATER THAT HELPED MAKE THE THINGS YOU USE.

Rise & Shine

TOILET
6 gallons/flush

LOW-FLOW TOILET
1.3 gallons/flush

SHOWER 10 MINUTES
3.8 gallons/minute

LOW-FLOW SHOWER 10 MINUTES
2.3 gallons/minute

FAUCET 1 MINUTE
5 gallons/minute

LOW-FLOW FAUCET 1 MINUTE
1.5 gallons/minute

TOTAL: 49 GALLONS

TOTAL: 25.8 GALLONS

AMOUNT SAVED: 23.2 GALLONS

Breakfast

COFFEE
37 gallons

TEA
9 gallons

EGGS TWO OF THEM
36 gallons/egg

CEREAL WITH MILK
22 gallons

APPLE
18 gallons

ORANGE
13 gallons

TOTAL: 127 GALLONS

TOTAL: 44 GALLONS

AMOUNT SAVED: 83 GALLONS

Lunch

SODA 16 OZ. BOTTLE
33 gallons

WATER 16 OZ. GLASS
.125 gallons

HAMBURGER
634 gallons

SALAD 1/2 lb. LETTUCE, 1/2 lb. TOMATO, 1/4 lb. CARROTS
31 gallons

TOTAL: 667 GALLONS

TOTAL: 31.125 GALLONS

AMOUNT SAVED: 635.875 GALLONS

Dinner

BEEF ONE POUND
1,500 gallons

WINE ONE GLASS
31 gallons

BREAD TWO SLICES
11 gallons/slice

DISH WASHING BY HAND
20 gallons

CHICKEN ONE POUND
287 gallons

BEER ONE PINT
20 gallons

BAKED POTATO
7 gallons

DISH WASHING W/ ENERGY STAR DISH WASHER
4 gallons

TOTAL: 1573 GALLONS

TOTAL: 318 GALLONS

AMOUNT SAVED: 1,255 GALLONS

Cleaning Up

WASHING MACHINE
40 gallons

WASHING MACHINE ENERGY STAR
22 gallons

TOILET
6 gallons/flush

LOW-FLOW TOILET
1.3 gallons/flush

BATH
35 gallons

NO BATH
0 gallons

FAUCET 1 MINUTE
5 gallons/minute

LOW-FLOW FAUCET 1 MINUTE
1.5 gallons/minute

TOTAL: 46 GALLONS

TOTAL: 2.8 GALLONS

AMOUNT SAVED: 43.2 GALLONS

Energy

NUCLEAR
255 gallons/day/household

SOLAR
24.5 gallons/day/household

AMOUNT SAVED: 230.5 GALLONS

TOTAL SAVED: 2,270.75 GALLONS

LEED™ and Water Use

LEED for New Construction and Major Renovation

Net Positive Water

Toronto Port Lands

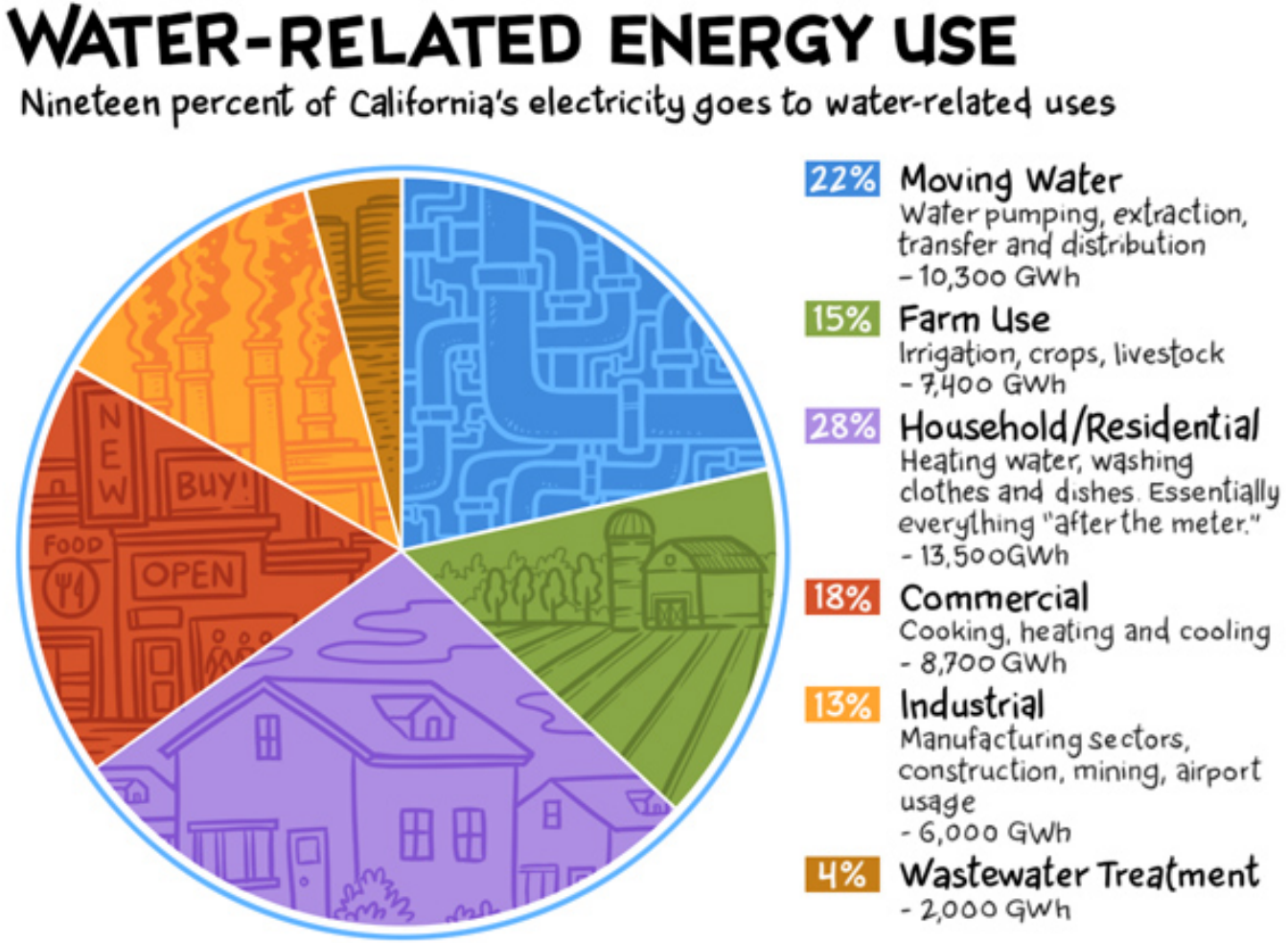
Yes	?	No			
			Sustainable Sites		**24 Points**
Y			Prereq 1	**Construction Activity Pollution Prevention**	Required
Y			Prereq 2	**Environmental Site Assessment**	Required
			Credit 1	**Site Selection**	1
			Credit 2	**Development Density & Community Connectivity**	4
			Credit 3	**Brownfield Redevelopment**	1
			Credit 4.1	**Alternative Transportation**, Public Transportation Access	4
			Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1
			Credit 4.3	**Alternative Transportation**, Low-Emitting and Fuel-Efficient Vehicles	2
			Credit 4.4	**Alternative Transportation**, Parking Capacity	2
			Credit 5.1	**Site Development**, Protect of Restore Habitat	1
			Credit 5.2	**Site Development**, Maximize Open Space	1
			Credit 6.1	**Stormwater Design**, Quantity Control	1
			Credit 6.2	**Stormwater Design**, Quality Control	1
			Credit 7.1	**Heat Island Effect**, Non-Roof	1
			Credit 7.2	**Heat Island Effect**, Roof	1
			Credit 8	**Light Pollution Reduction**	1
			Credit 9	**Site Master Plan**	1
			Credit 10	**Joint Use of Facilities**	1
			Water Efficiency		**11 Points**
Y			Prereq 1	**Water Use Reduction**, 20% Reduction	Required
			Credit 1	**Water Efficient Landscaping**	2 to 4
			Credit 2	**Innovative Wastewater Technologies**	2
			Credit 3	**Water Use Reduction**	2 to 4
			Credit 4	**Process Water Use Reduction**	1
			Energy & Atmosphere		**33 Points**
Y			Prereq 1	**Fundamental Commissioning of the Building Energy Systems**	Required
Y			Prereq 2	**Minimum Energy Performance**	Required
Y			Prereq 3	**Fundamental Refrigerant Management**	Required
			Credit 1	**Optimize Energy Performance**	1 to 19
			Credit 2	**On-Site Renewable Energy**	1 to 7
			Credit 3	**Enhanced Commissioning**	2
			Credit 4	**Enhanced Refrigerant Management**	1
			Credit 5	**Measurement & Verification**	2
			Credit 6	**Green Power**	2

Water use reduction by:

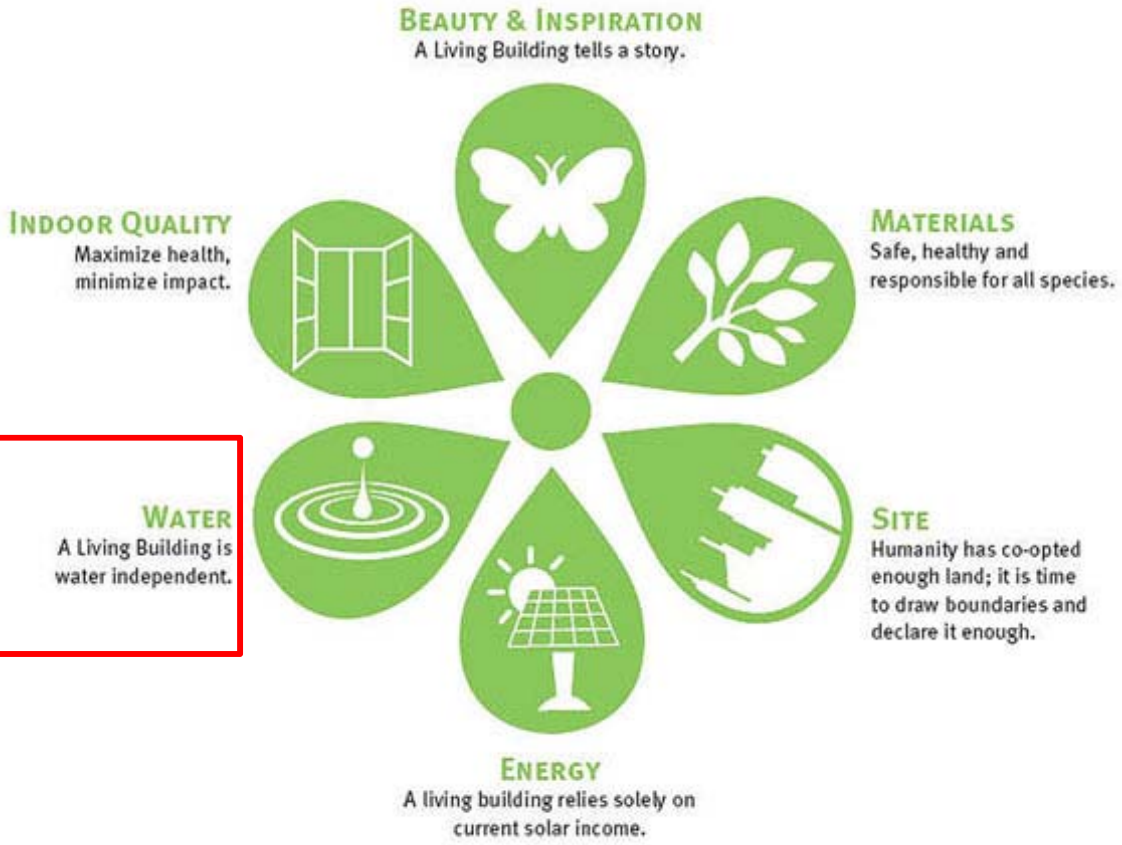
- Efficient landscaping
- No potable use on landscape
- Efficient fixtures

STILL ALLOWS USE OF DRINKING WATER FOR TOILET FLUSHING.

Water and Energy



The Living Building Challenge



Living Building Challenge and Water

LBC requires buildings to be "water independent"

Uses:

- Water harvesting
- Water banking
- Water cleaning
- Separation of streams of water

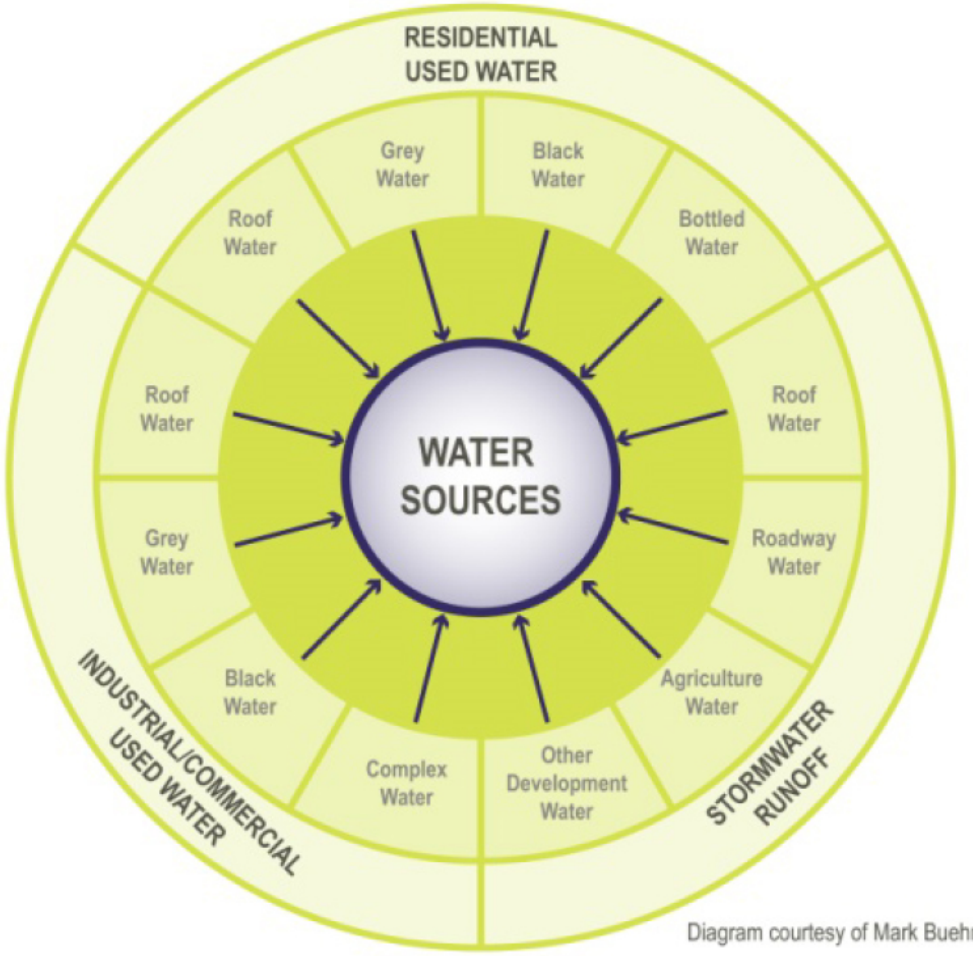
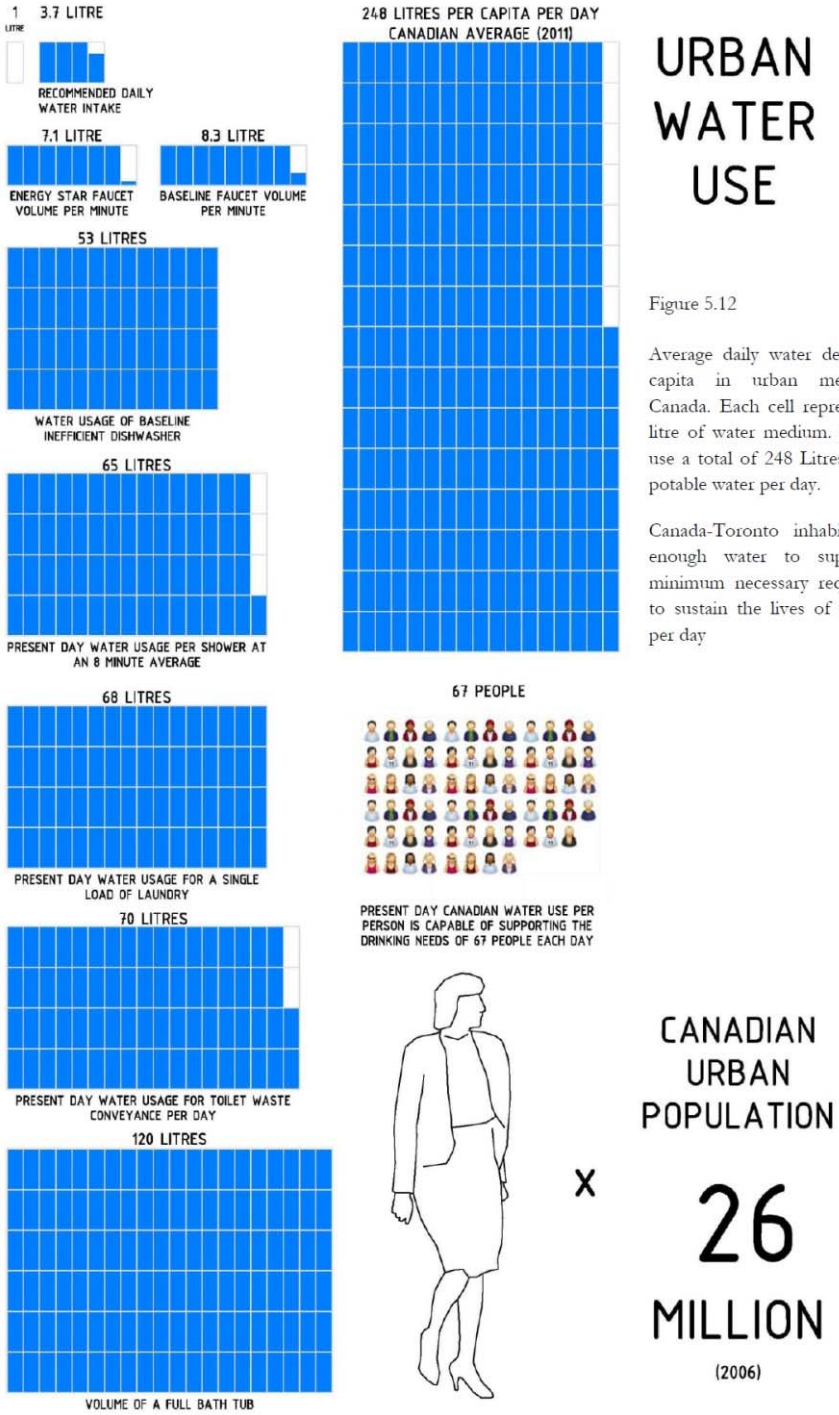


Diagram courtesy of Mark Buehrer

Urban Water Use

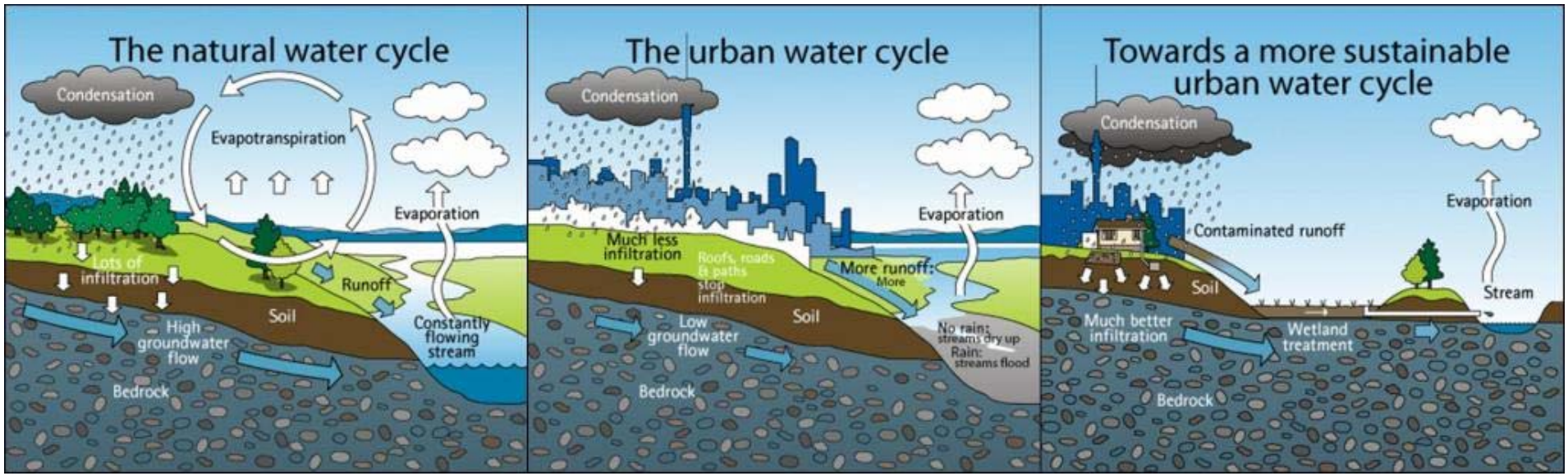
Average daily water demand per capita in urban metropolitan Canada. Each cell represents one litre of water. Canadians use a total of 248 litres of fresh, potable water per day.

Toronto inhabitants use enough water to support the minimum necessary requirements to sustain the lives of 67 people per day.



Ideal View of the Water Cycle

Urban Water Cycle



- Promote infiltration into the soil
  - Pervious paving and landscape
- Collect and clean contaminated runoff
- Divert from storm sewers
- Create wetlands and bioswales for natural cleaning and to slow runoff
- Use greenroofs to hold water to slow entry into the urban water cycle

Sustainable Water Cycle

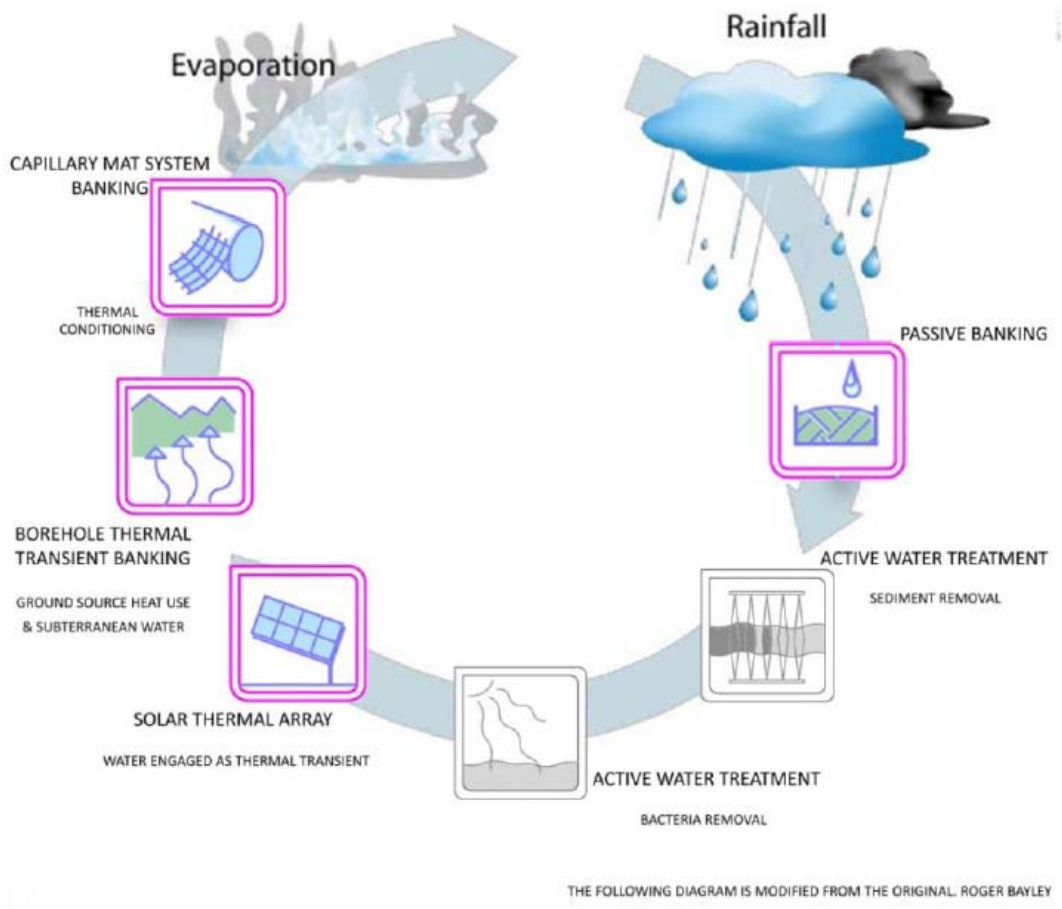
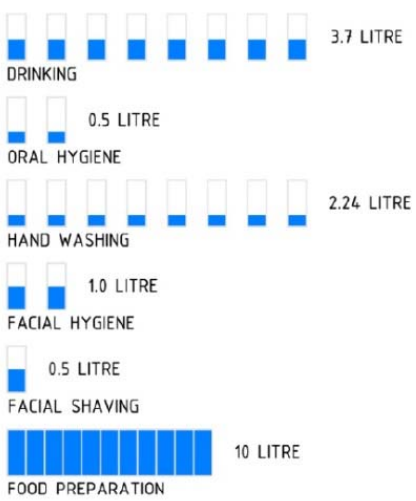


Figure 7.34

Net Positive Water – Water renewal Cycle.

Active Water treatment and renewal functions in the Mid-rise Pilot Project.

Daily Adequate Potable Water Use

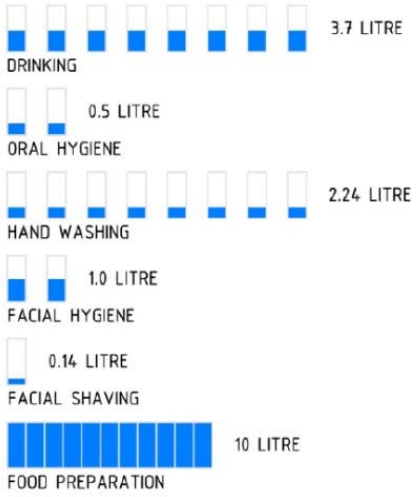


DAILY ADEQUATE POTABLE USE

(AVERAGE)

MEN

17.94LPCD

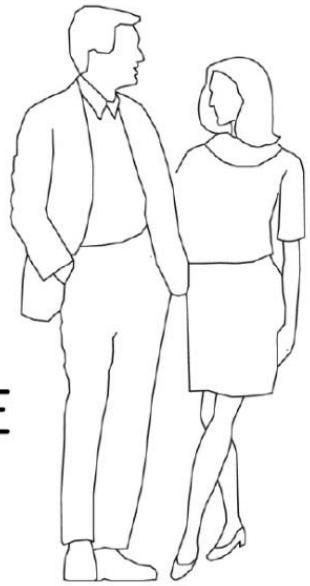


DAILY ADEQUATE POTABLE USE

(AVERAGE)

WOMEN

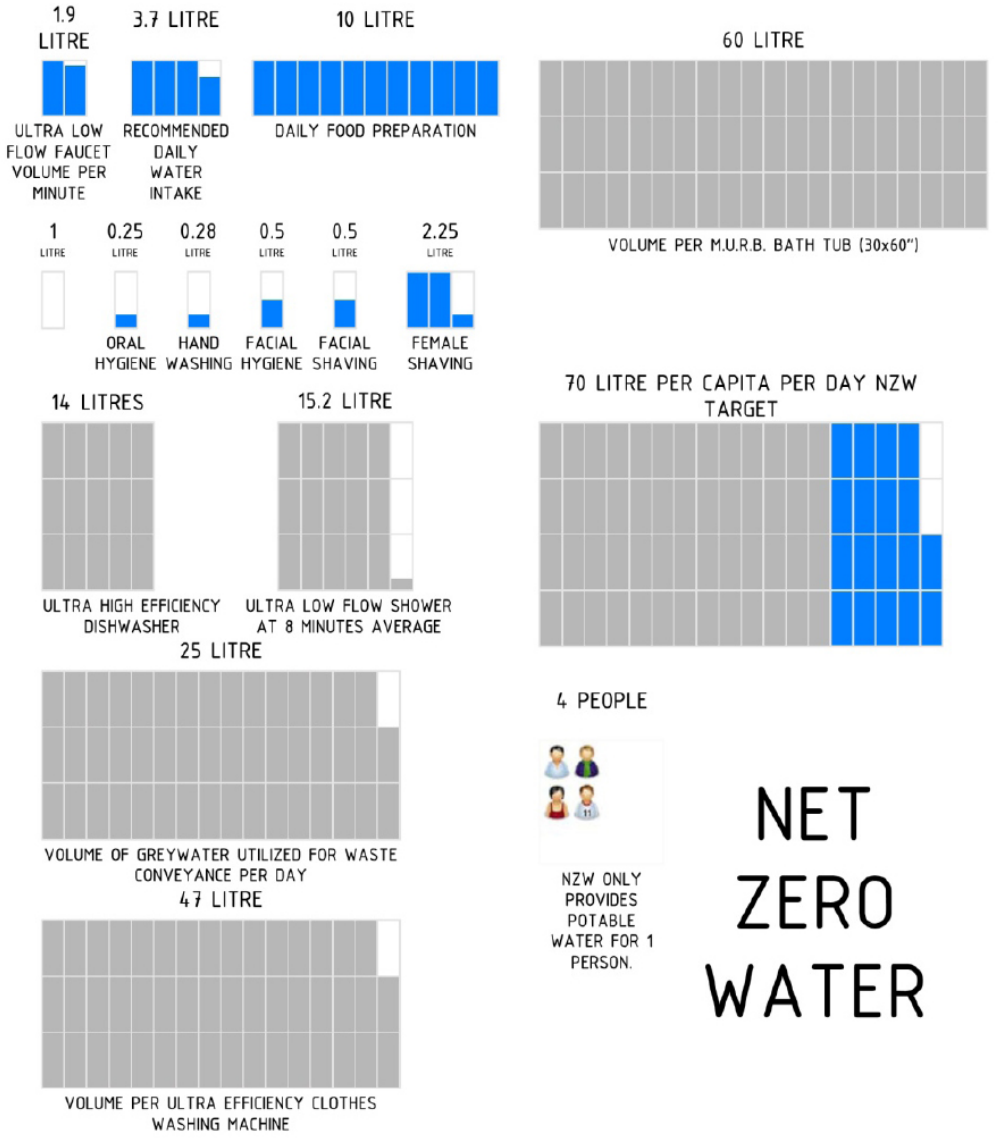
17.58LPCD



Net Zero = 70 litres/day

Develop systems in our buildings to clean/use greywater for all non potable uses.

Do NOT flush drinking water down



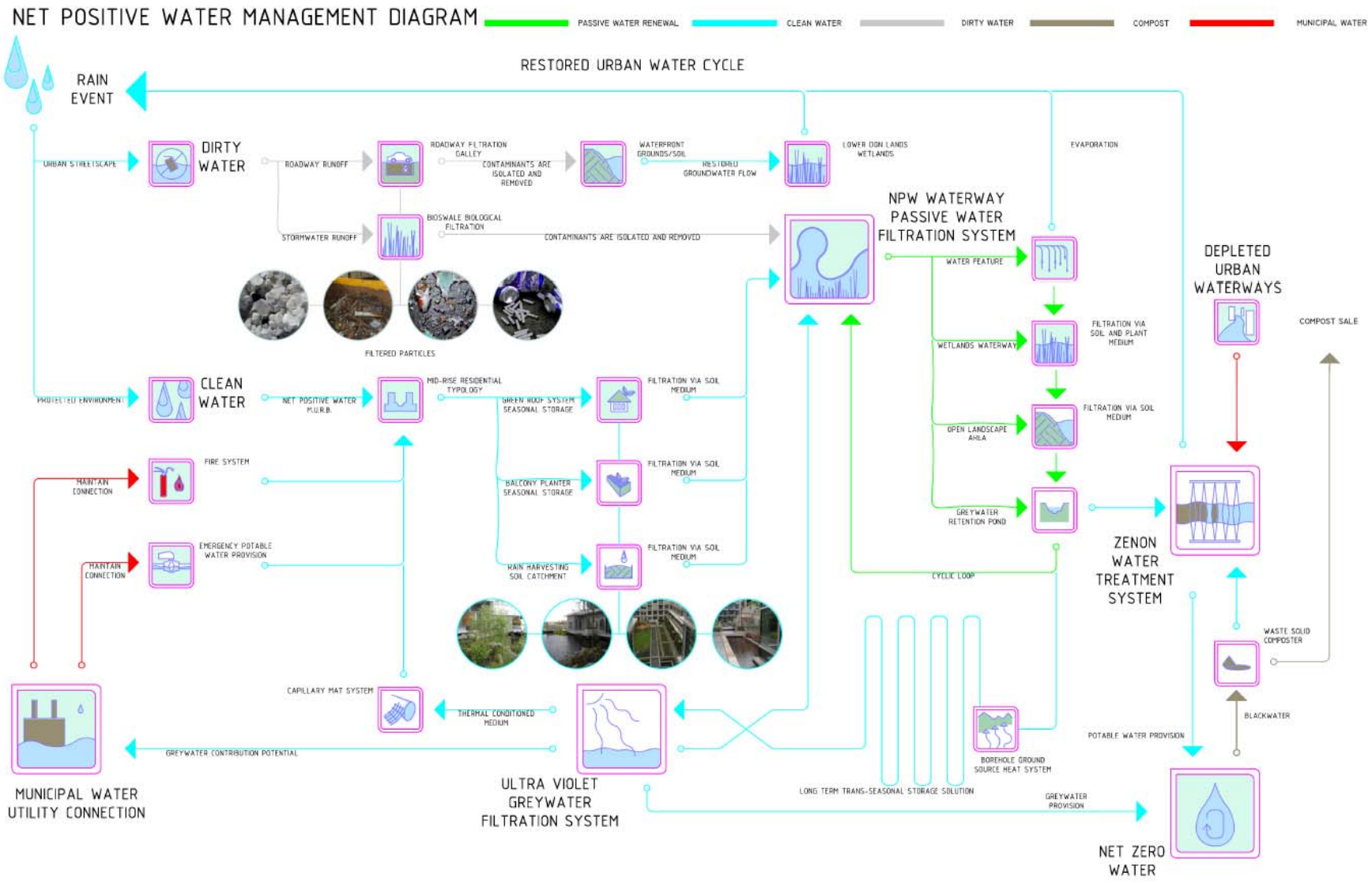
Potable Water

Greywater

Net Zero Water MURB

Multi Unit Residential Proposal by Billy Ma for UWSA Thesis

Net Positive Water Proposal



Plan View

Figure 7.27

This figure displays the coverage of Green Roof Systems on the NPW pilot project. Green Roof systems can support native shrub and plant species due to the depth of the planter design (Fig. 7.20 Pg. 163)

Open space corridors are covered with glass canopies that divert rainfall onto Green roof systems. This directs the resource away from Dirty inhabitant pathways.

Solar thermal panels are installed to transition solar energy in the form of hot water transient to meet the buildings thermal conditioning demands.

Building Water Storage Methods

Active water storage mechanisms consist of the following:

Rain Barrels (induce flow)
Cisterns (induce flow)
Storage Tank (bladder, pillow, pressure)
Condensing units (heat transfer thermal conditioning)
Radiant heating systems (no water additives, no corrosive construction)
Ground source heat pumps utilizing greywater
Solar Thermal Array utilizing greywater

Passive water storage mechanisms consist of the following:

Green Roofing Systems
Vegetation Planters
Landscape sod with supporting soil content
Paving substrate
Bioswale Landscaping with supporting substrate
Water Features (induce flow)
Naturalized Waterway (induce flow)

These are the simple ways that we can address water conservation in our buildings.

Water Harvesting

We can use the shape and surface types of our buildings to gather or “harvest” rainwater to stretch its use throughout the year.

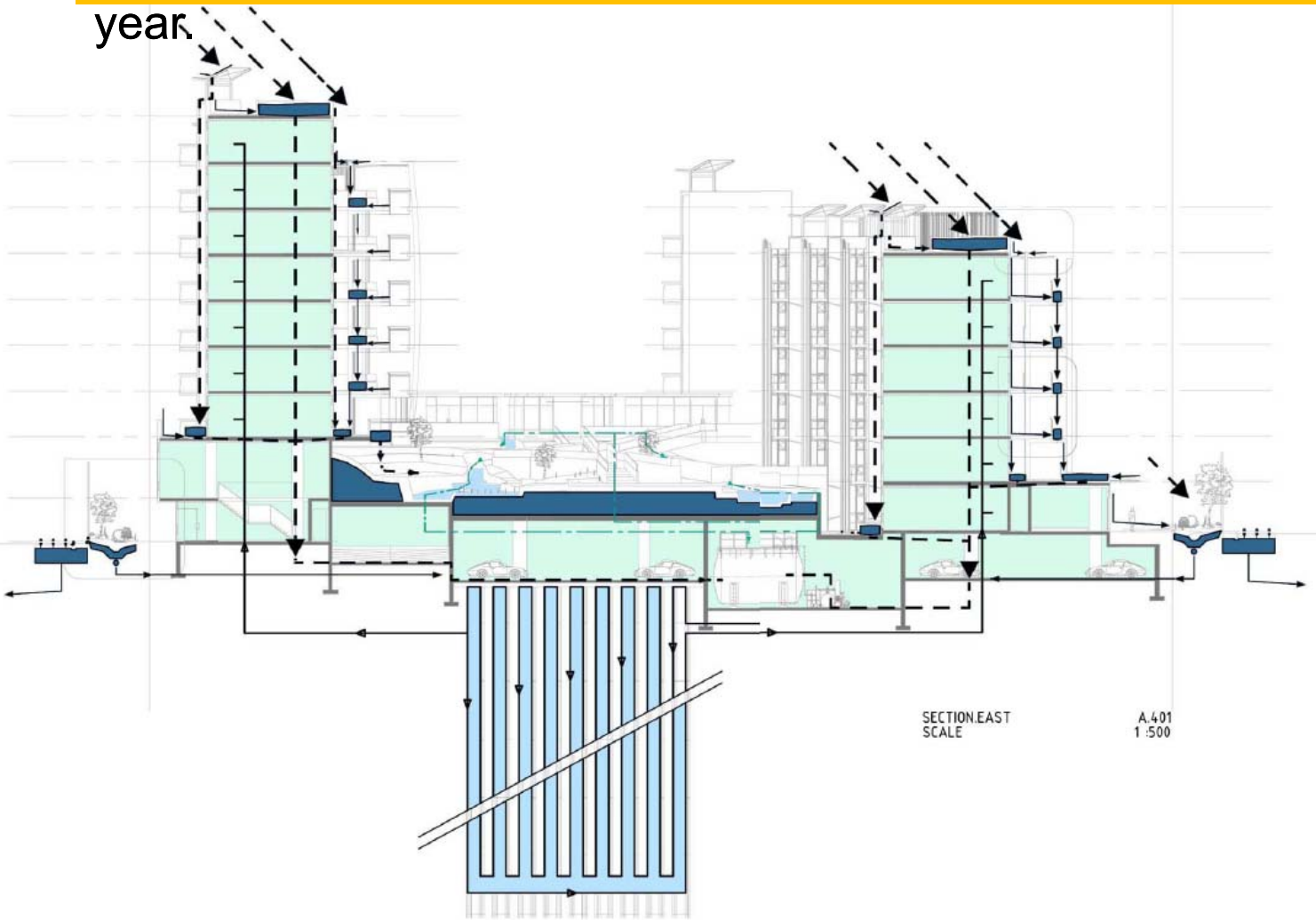


Figure 7.29

This diagram is a visual representation of Water Harvesting on-site utilizing NPW guidelines. The display showcases the following strategies deployed for sustainable urban water management:

- NPW Clean & Dirty Water Management
- NPW Interior & Exterior Drainage Management
- NPW Passive Water Harvesting
- NPW Active Water Treatment Systems
- NPW Cycle

On-site & Building water distribution reflects prescribed NPW guidelines.

Active and Passive Water Banking

Water “banking” looks at the places that “harvested” water can be stored.

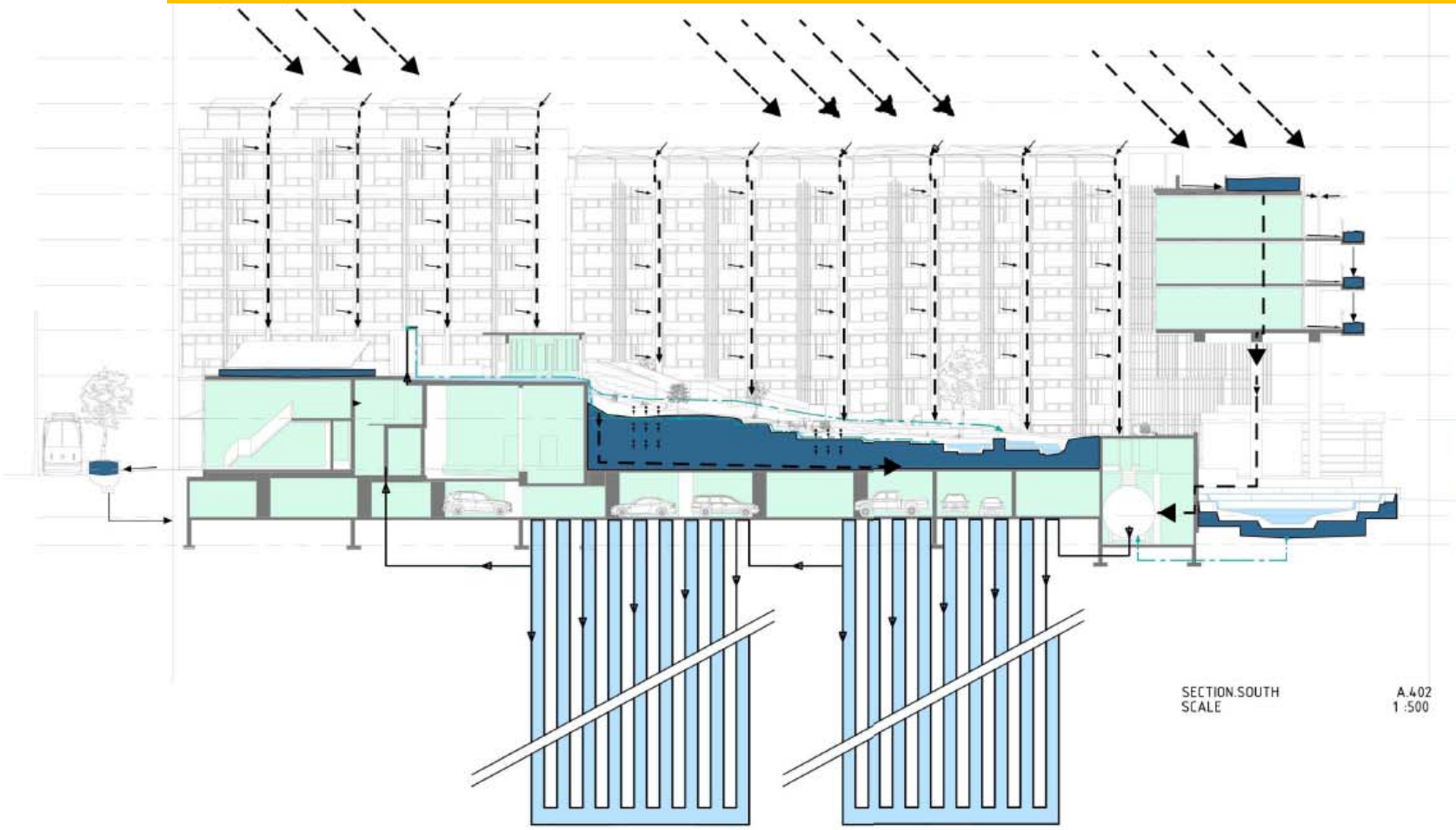


Figure 7.30

This diagram showcases Active and Passive Water Banking. Water is ‘banked’ within on-site soil volume under:

- Green Roof Systems designed for regional water resource harvesting.
- Vertical Percolation Strategy in planter boxes
- Landscaped Podium and Naturalized Waterway
- Borehole Water Storage
- Phase One Water Sediment Treatment
- Phase Two UV Water Treatment

North American Status Quo Unsustainable