River Bank Filtration for Wastewater Reuse in Irrigation: Adaptation to Climate Change

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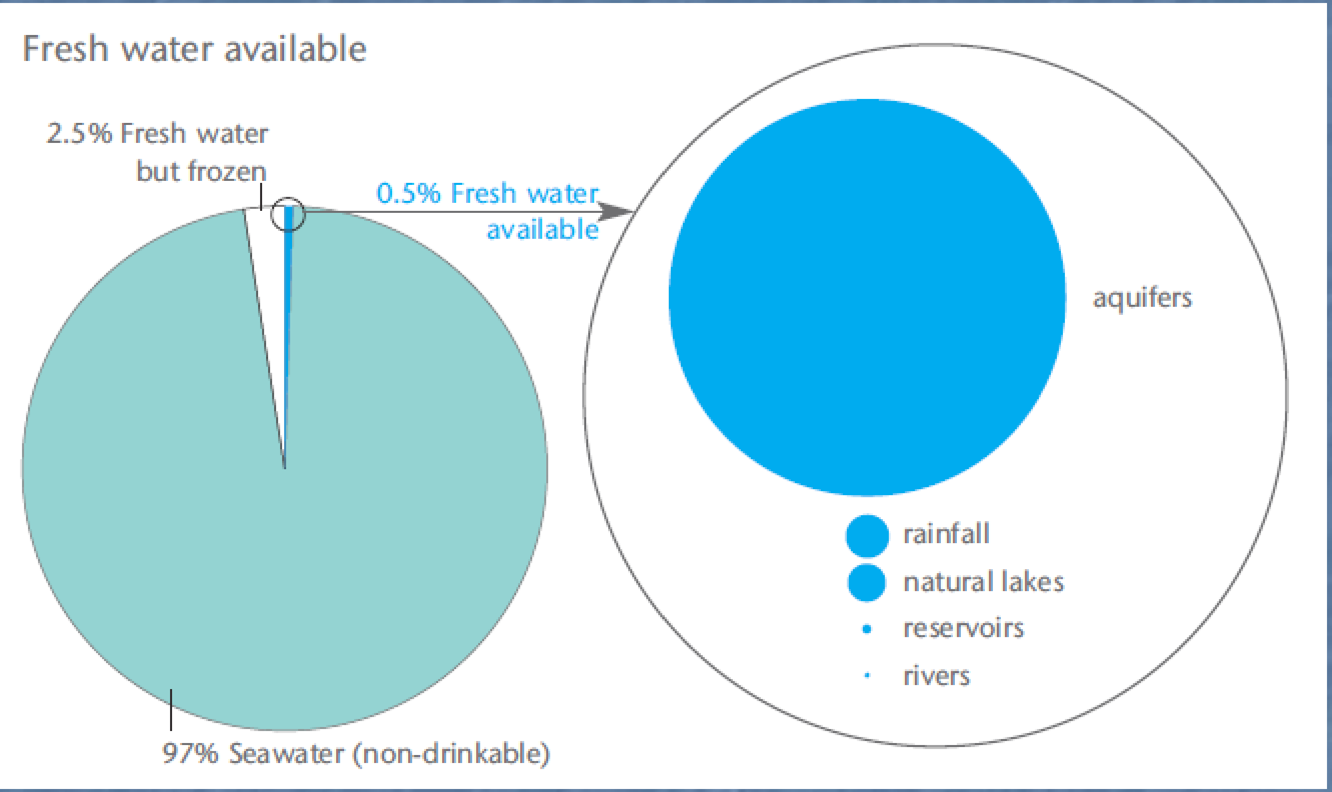
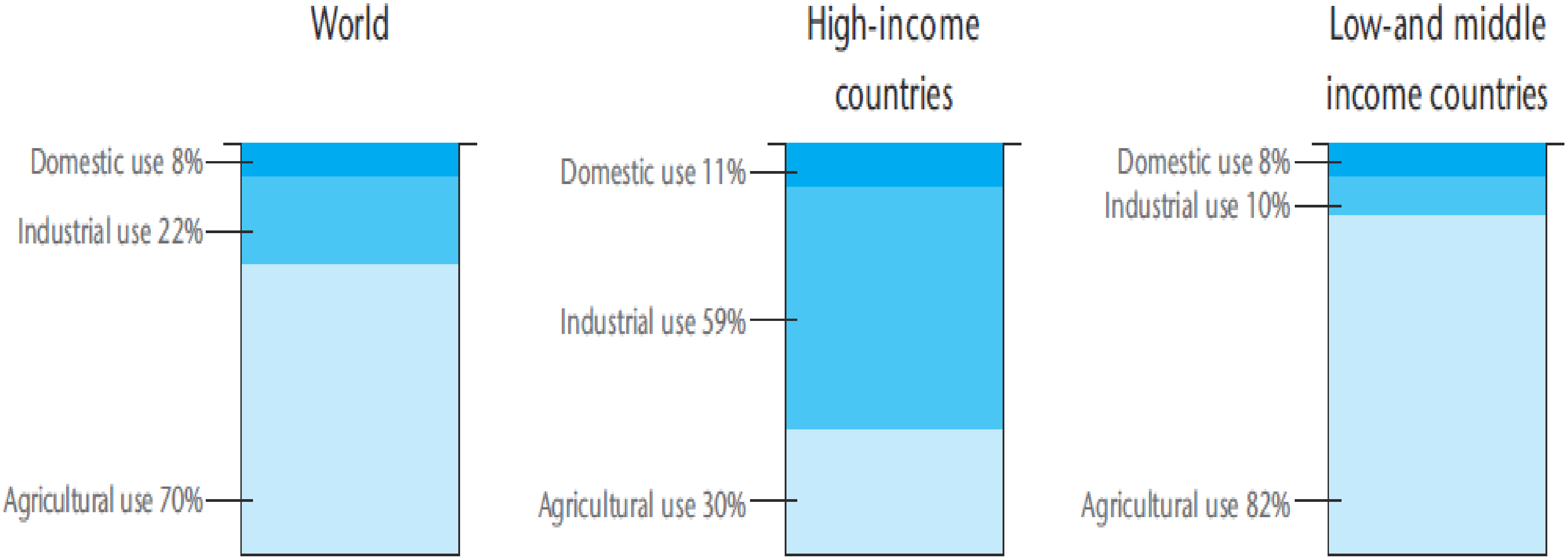

Fresh water available
2.5% Fresh water but frozen
0.5% Fresh water available
97% Seawater (non-drinkable)
aquifers
rainfall
natural lakes
reservoirs
rivers

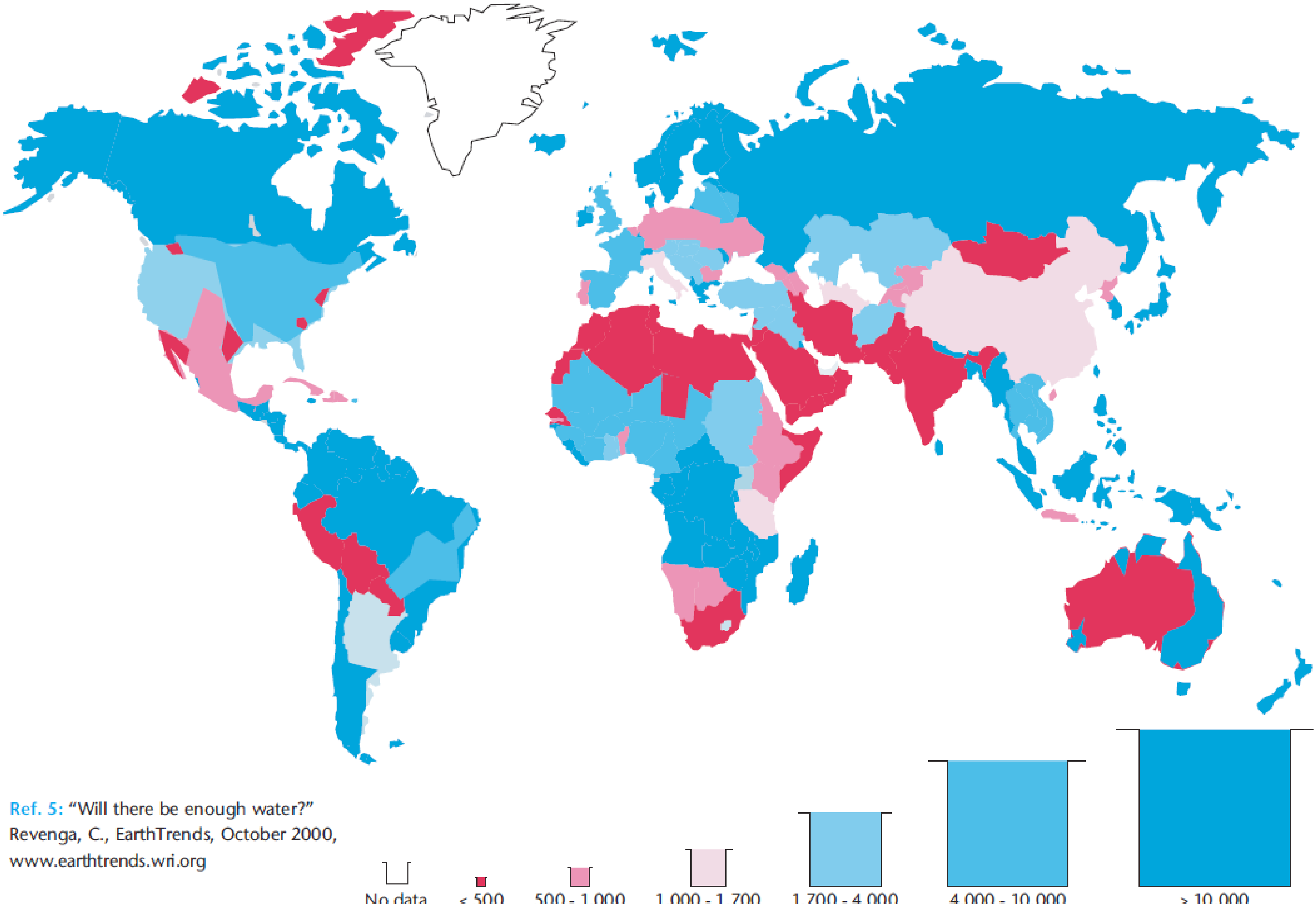
Competing water uses for main income groups of countries[6]

Industrial use of water increases with country income, going from 10% for low- and middle- income countries to 59% for high-income countries.



Ref. 6: "Water for People, Water for Life" United Nations World Water Development Report, UNESCO, 2003
www.unesdoc.unesco.org

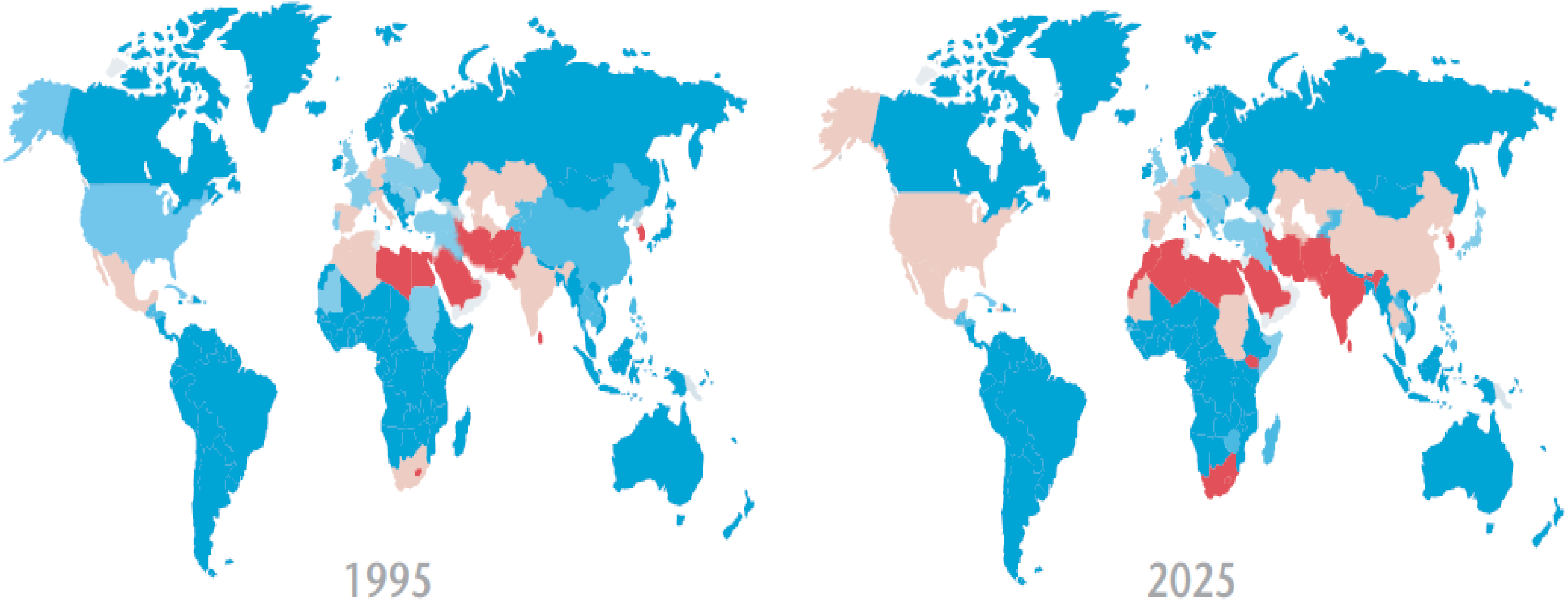
Annual renewable water (m^3/person/year)[5]

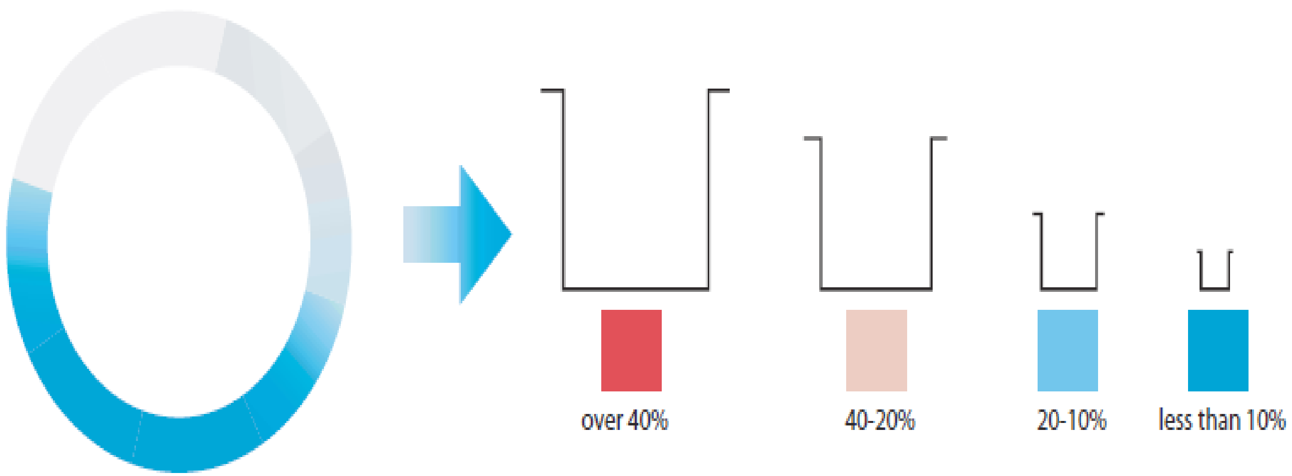


Ref. 5: "Will there be enough water?" Revenga, C., EarthTrends, October 2000, www.earthtrends.wri.org

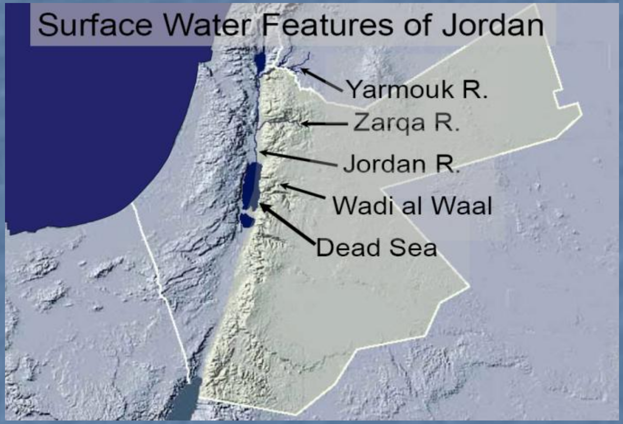
Fresh water stress

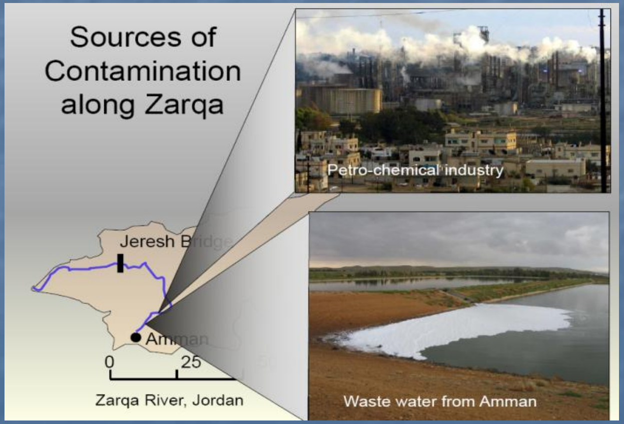
The following map projects how much water will be withdrawn with respect to the amount that is naturally available.[18]

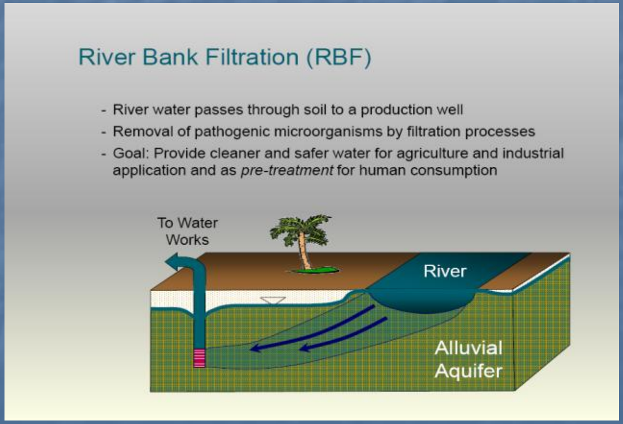




Already strained WRs will be more impacted by CC

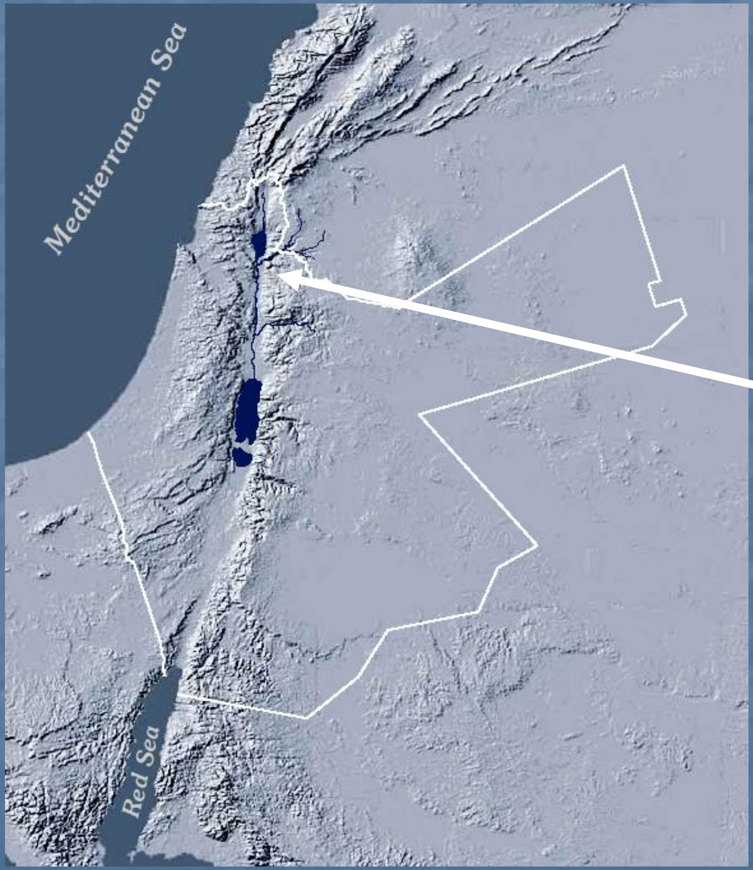




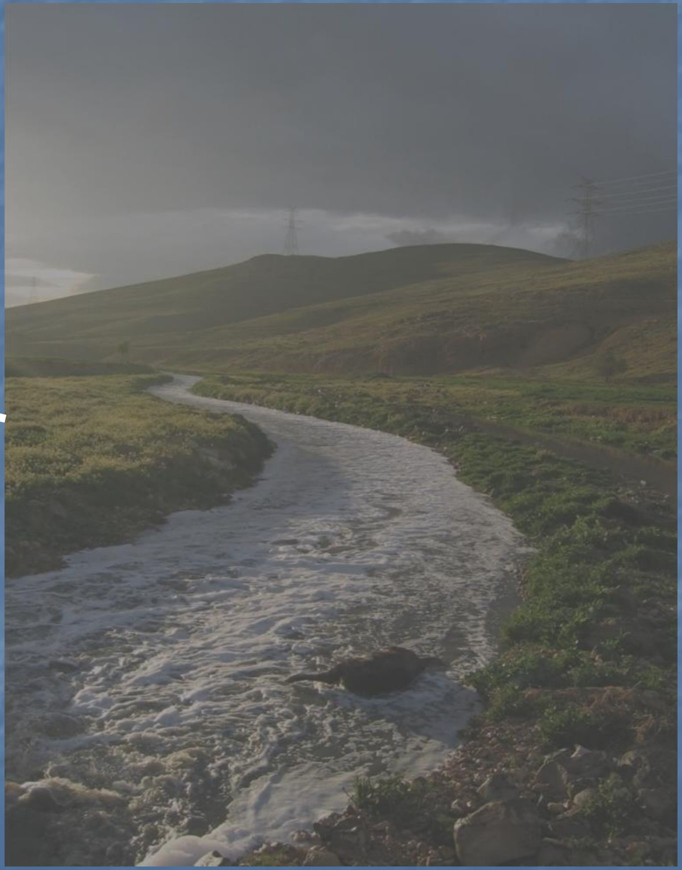


Evaluation of Riverbank Filtration for Protection of Jordanian Surface and Ground Water Resources

Evaluation of Riverbank Filtration for Protection of Jordanian Surface and Ground Water Resources SfP-981454



Satellite Map of Jordan



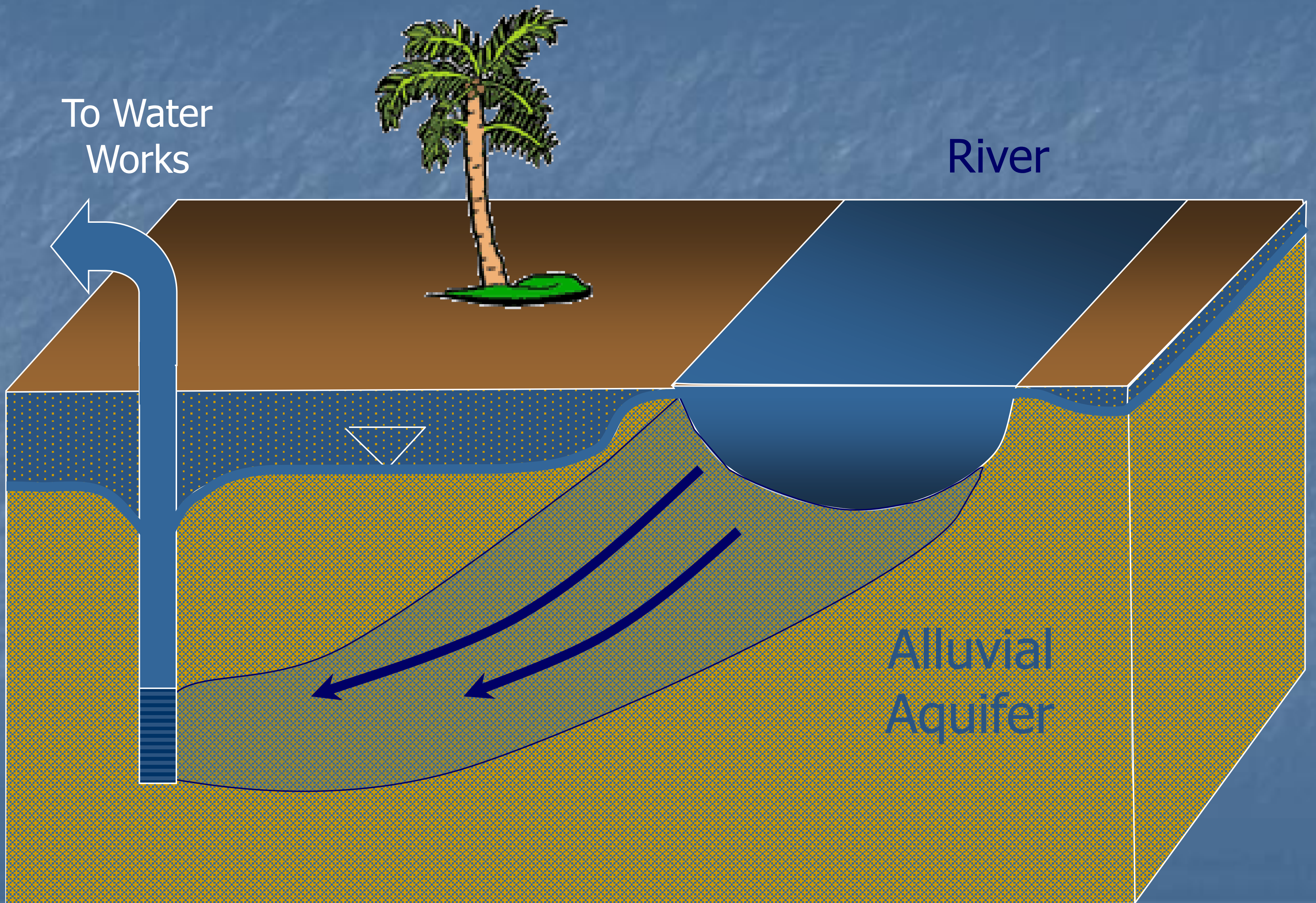
Zarqa River, Jordan

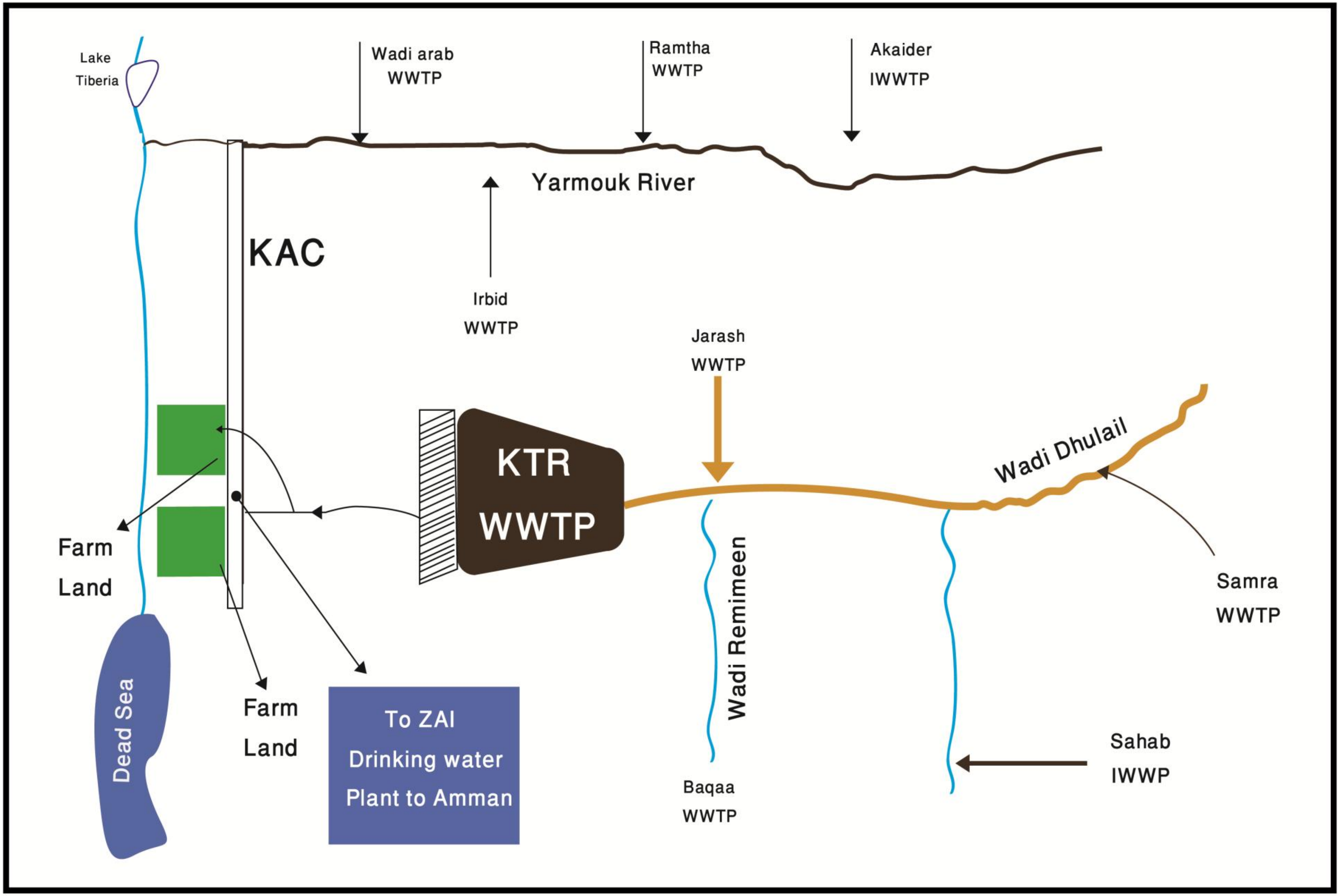

22 1 2006


22 1 2006


22 1 2006

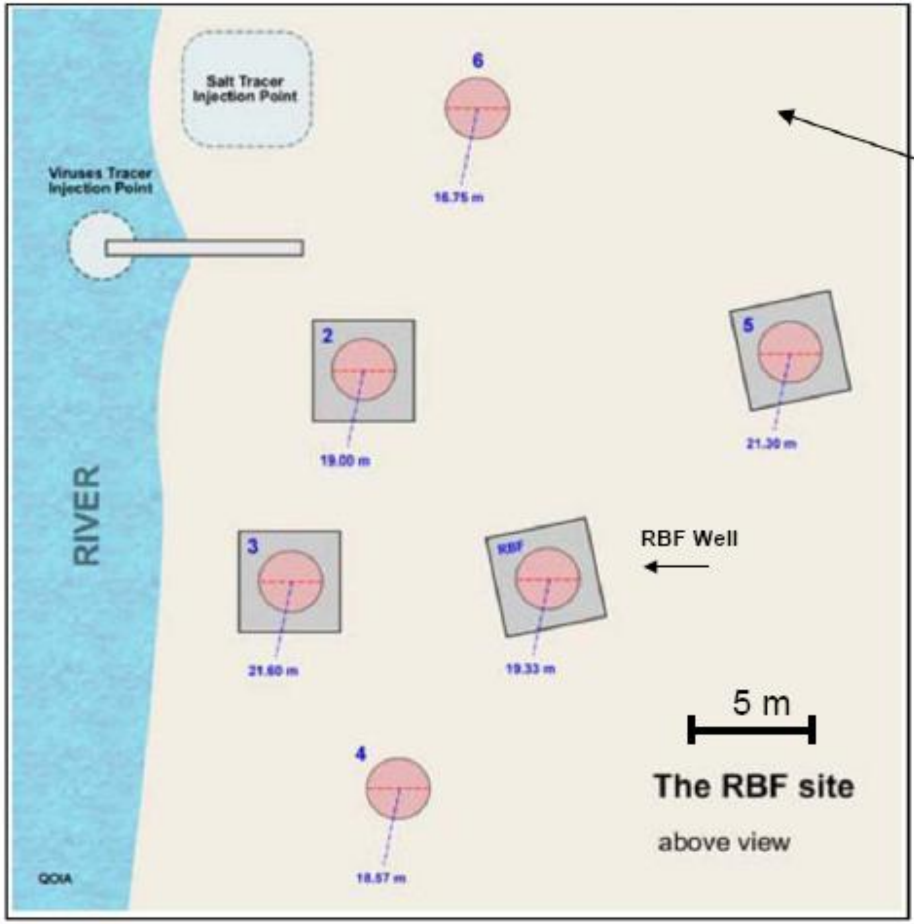
Riverbank Filtration





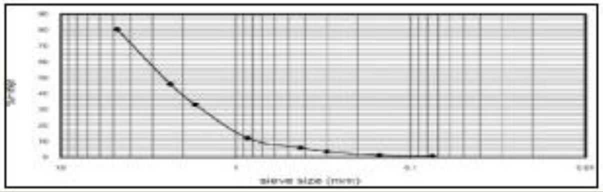
Lake
Tiberia
Wadi arab
WWTP
Ramtha
WWTP
Akaider
IWWTP
Yarmouk River
KAC
Irbid
WWTP
Jarash
WWTP
KTR
WWTP
Wadi Dhulail
Wadi Remimeen
Farm
Land
Samra
WWTP
Dead Sea
Farm
Land
To ZAI
Drinking water
Plant to Amman
Sahab
IWWP
Baqaa
WWTP

Installation of RBF system

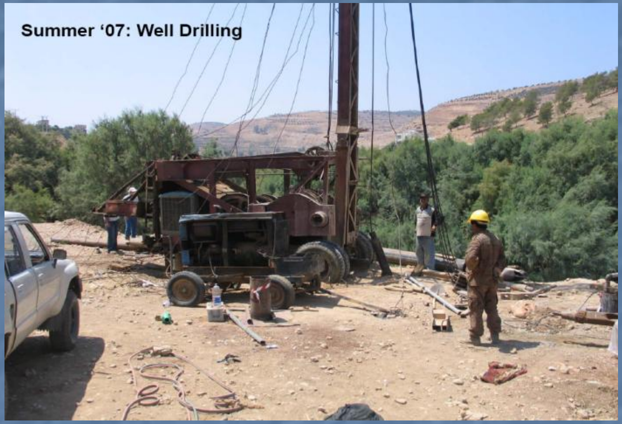


Staging area with temporary housing.

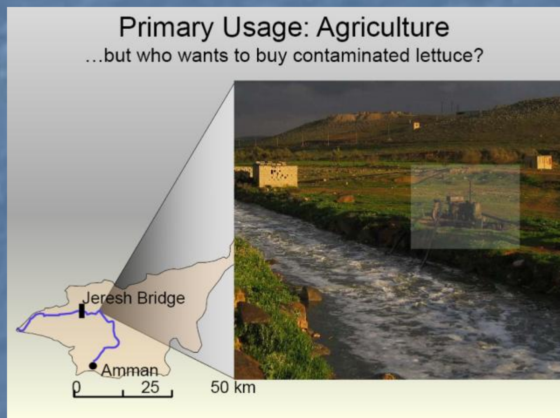
Soil Property	Measurement
Sand (%)	90
Clay (%)	1.00
Silt (%)	9.00
Water saturation (%)	16
pH	8.27
Organic Matter (%)	0.01
CEC (meq/100 g-soil)	3
USDA Soil Classification	Sand

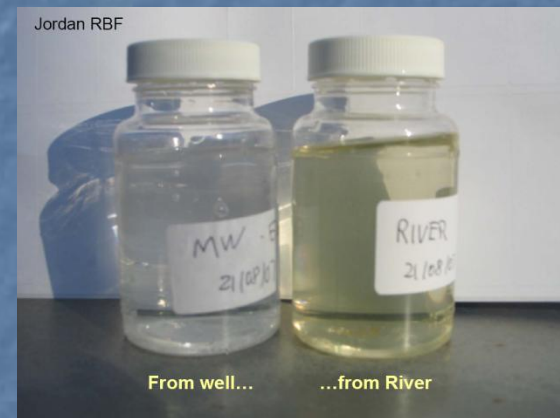


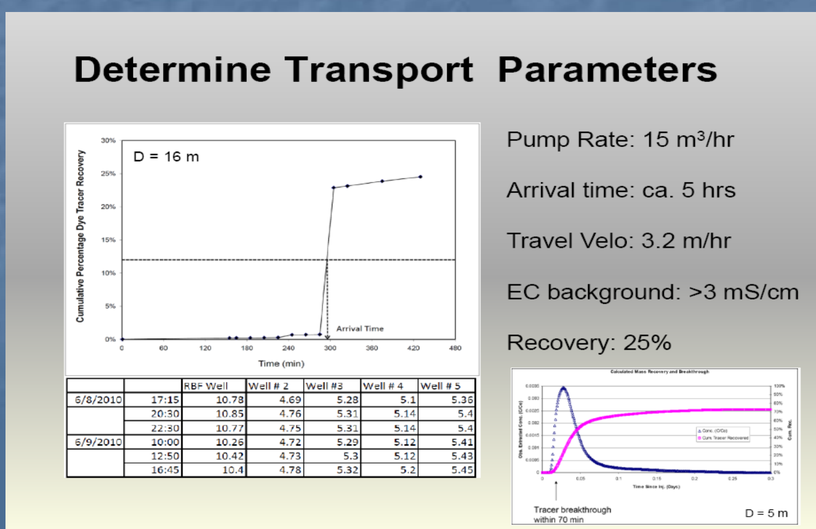
4 Years of Research in 6 Slides!!



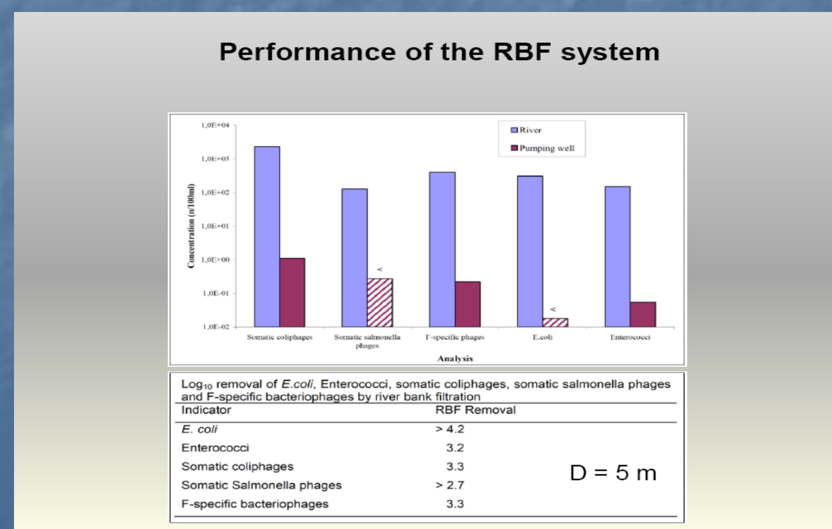
Water Reuse…Indispensable!







		RBF Well	Well # 2	Well #3	Well # 4	Well # 5
6/8/2010	17:15	10.78	4.69	5.28	5.1	5.36
	20:30	10.85	4.76	5.31	5.14	5.4
	22:30	10.77	4.75	5.31	5.14	5.4
6/9/2010	10:00	10.26	4.72	5.29	5.12	5.41
	12:50	10.42	4.73	5.3	5.12	5.43
	16:45	10.4	4.78	5.32	5.2	5.45



Log_{10} removal of *E.coli*, Enterococci, somatic coliphages, somatic salmonella phages and F-specific bacteriophages by river bank filtration

Indicator	RBF Removal
E. coli	> 4.2
Enterococci	3.2
Somatic coliphages	3.3
Somatic Salmonella phages	> 2.7
F-specific bacteriophages	3.3

Summary and Implications

- 3.3 – 3.4 log removal of bacteria and bacteriophages over 5 m of RBF at 10 m^3/h

- **<u>Risk reduction: 2000 – 2500 times</u>**

➔RBF system significantly reduced public health risks from exposure to untreated river water, like consumption of raw vegetables irrigated with this water.

➔RBF water is being used in agribusiness.

➔Our approach to RBF can be replicated.