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Climate Change and Smart Water Management

AIEC2018 - Climate Change and Sustainability

March 6-7, 2018



Water infrastructure in Roman times



Ephesus (100 BC)





How far have we come?





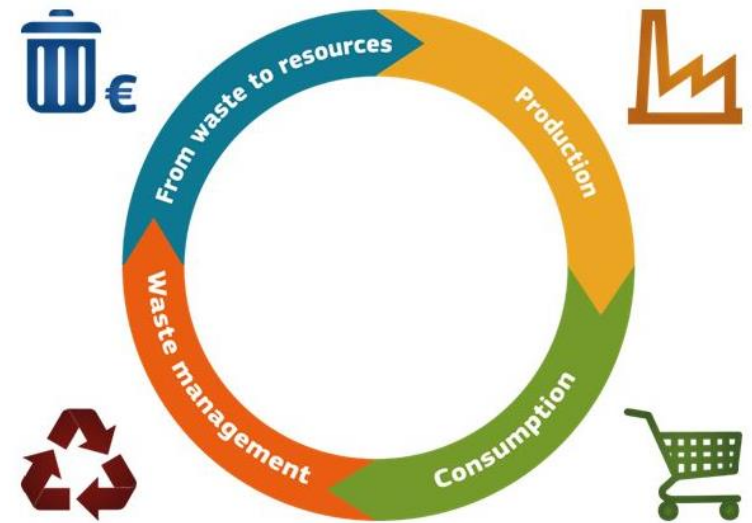
What advances have we made?





It is time for smart water management!

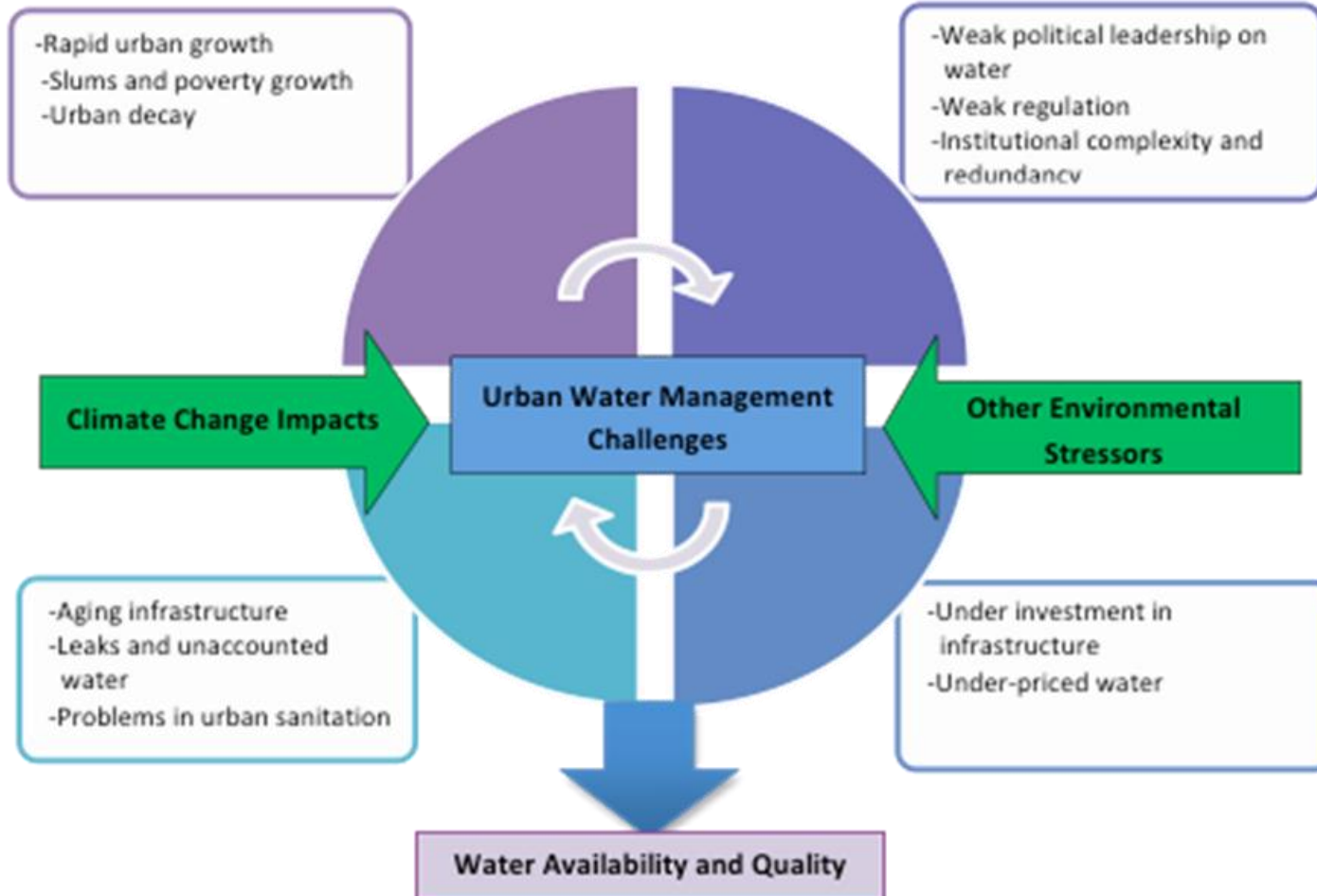
- Population increase
- Climate change
- Environmental pollution
- Increasing water scarcity
- Increasing energy demands
- Deteriorating water infrastructure



Circular economy

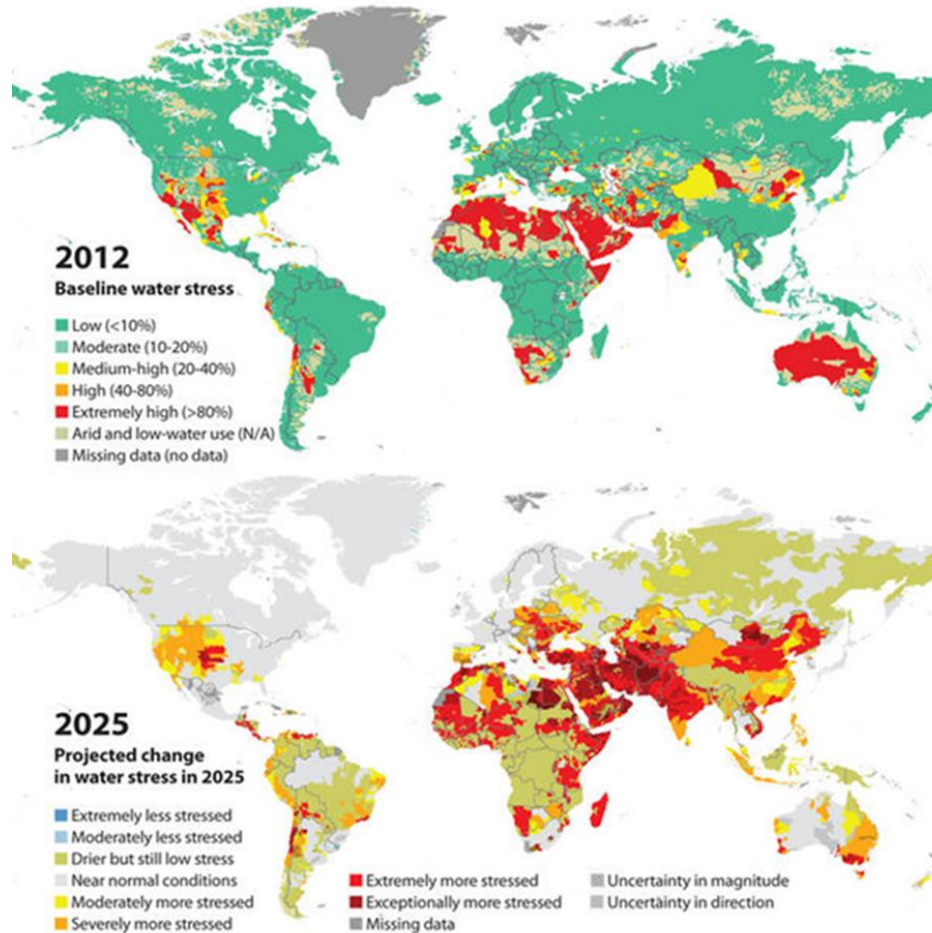


Urban water issues





Water availability and quality



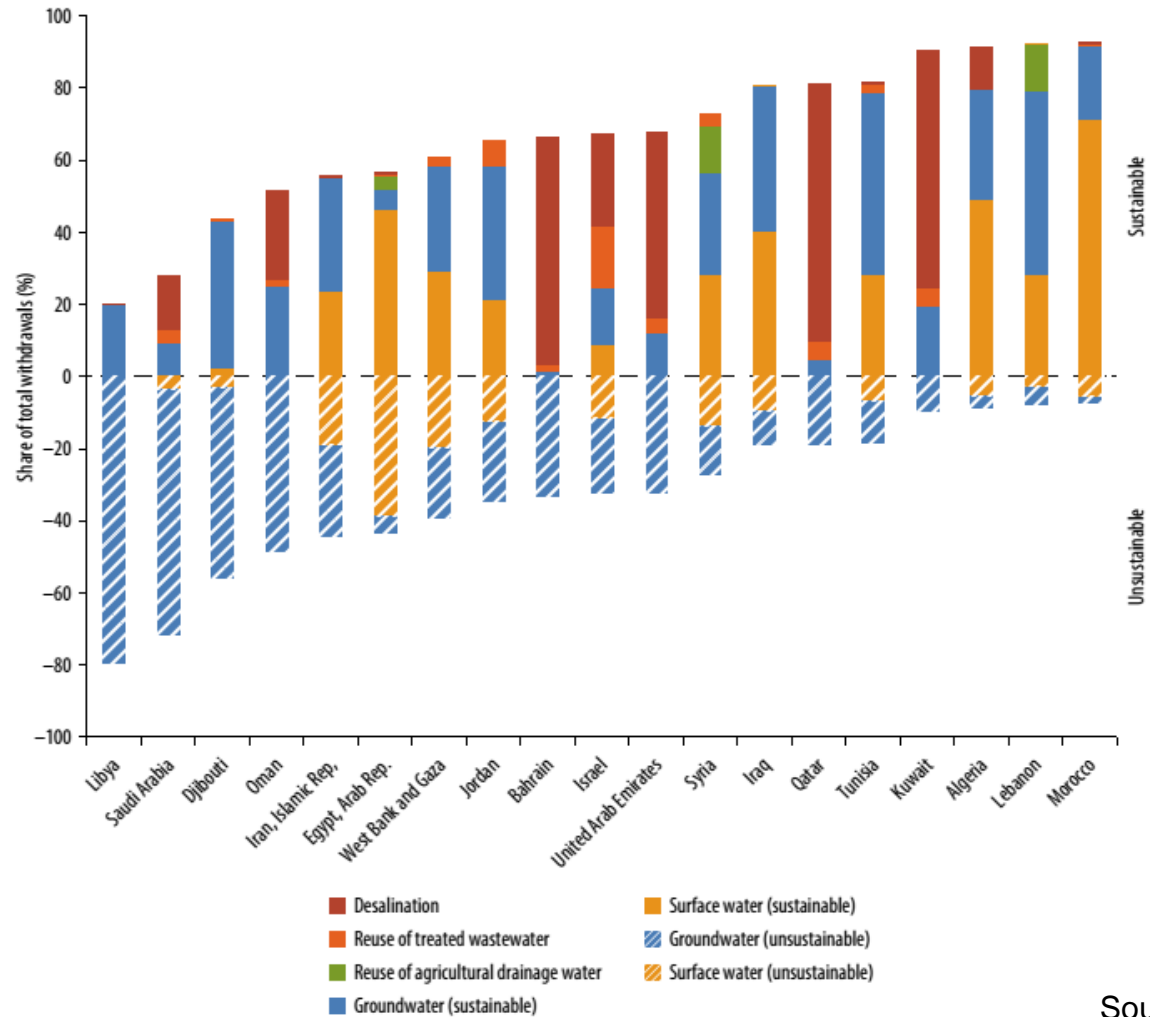
SOURCE: World Resources Institute; Global map data courtesy of the Coca-Cola Company

RICH CLABAUGH/STAFF

Source: World Resources Institute (2014).

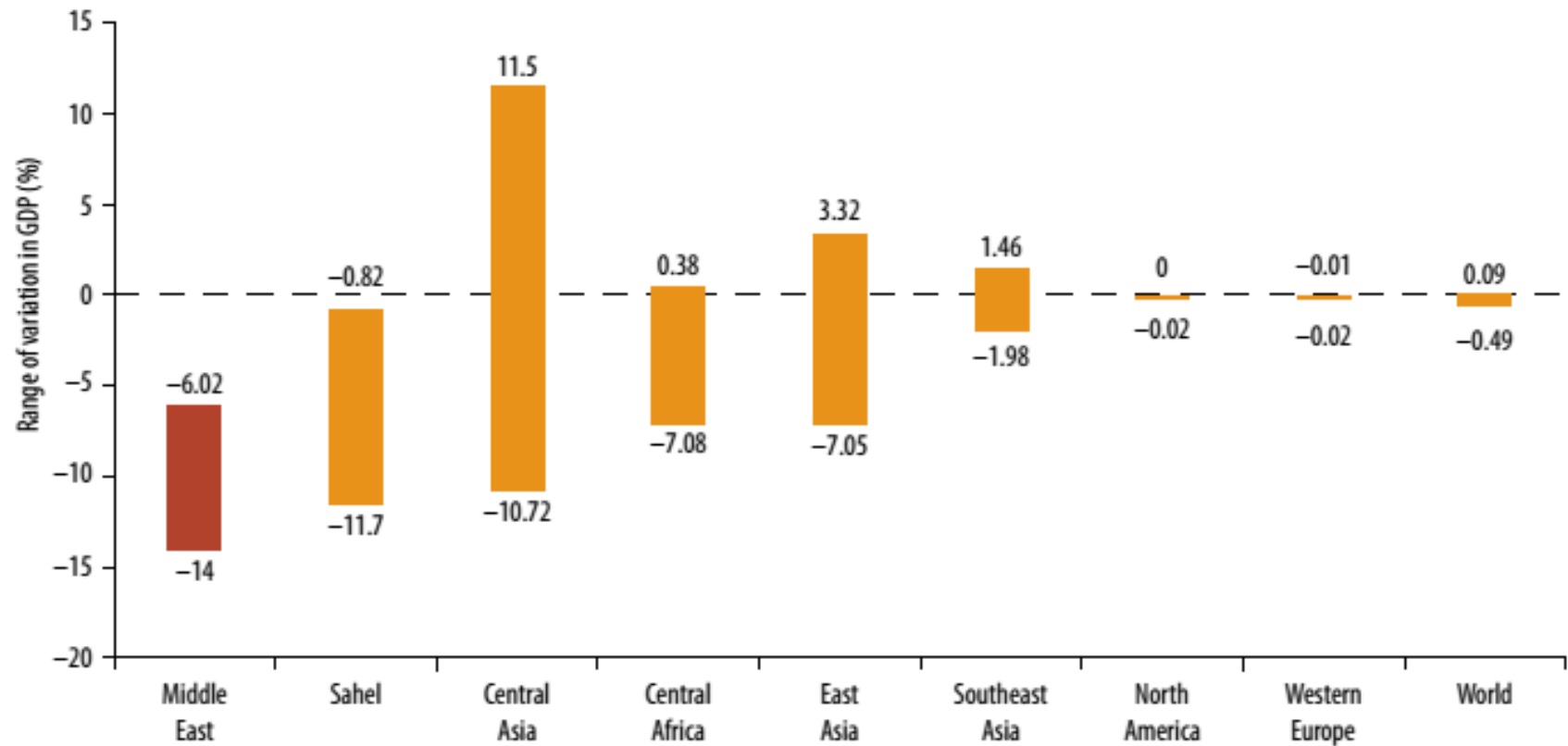


Sustainability of Water Withdrawals, by Source



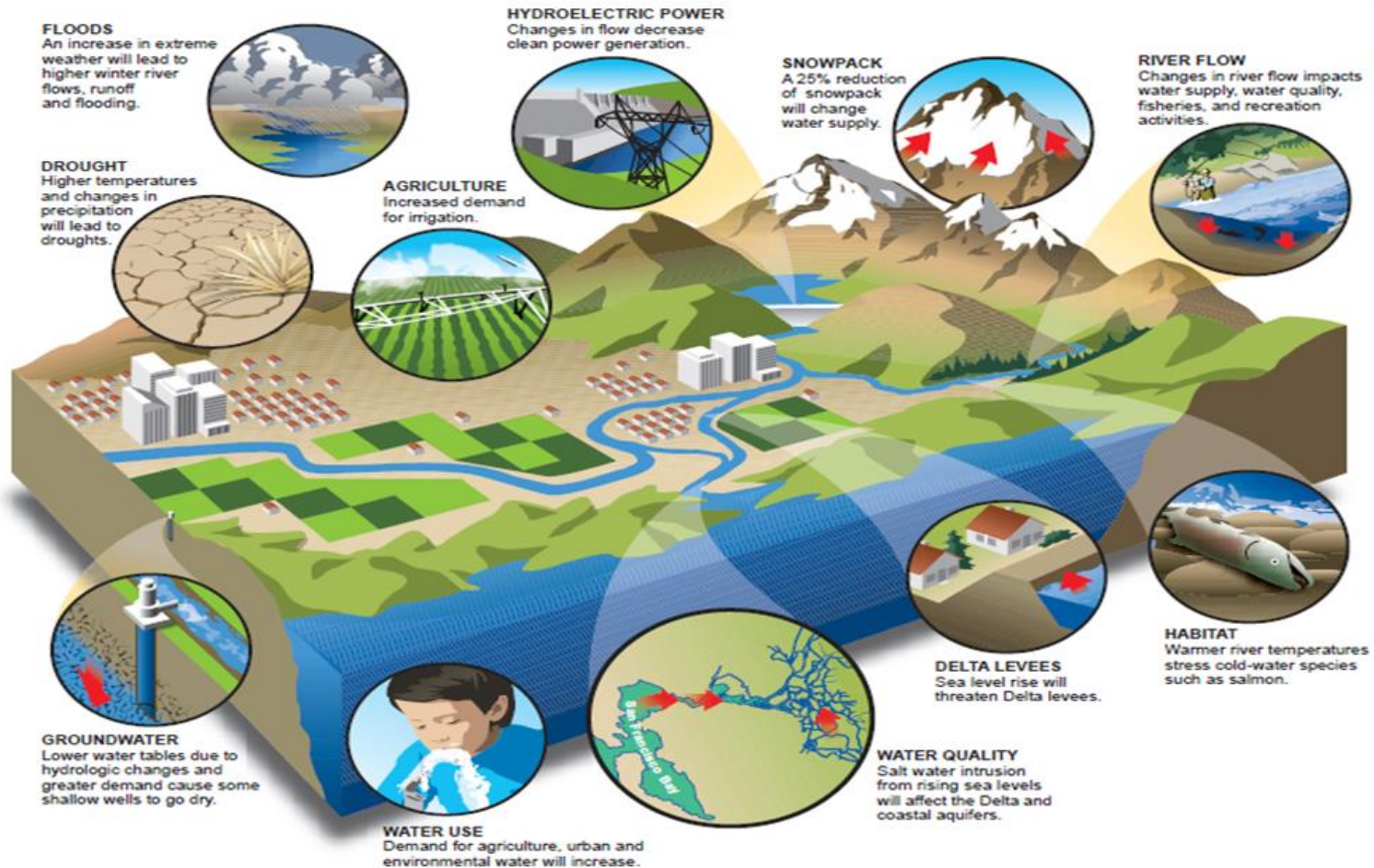


The Economic Impacts of Climate Change-Induced Water Scarcity, by 2050





Climate change effects





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SON DAKİKA

CNN
TURK

İSTANBUL'DA SEL FELAKETİ

İKİTELLİ VE HALKALI'DA 16 KİŞİ HAYATINI KAYBETTİ

5° MUĞLA: PARÇALI ÇOK BULUTLU 24° ANTALYA: PARÇA

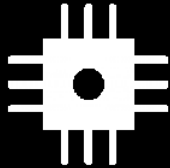
cnnturk.com



Let's build a smarter planet: IBM Smarter Water Management



Something profound is happening...



INSTRUMENTED

We now have the ability to measure, sense and see the exact condition of practically everything.



INTERCONNECTED

People, systems and objects can communicate and interact with each other in entirely new ways.



INTELLIGENT

We can respond to changes quickly and accurately, and get better results by predicting and optimizing for future events.





Smart water management technologies



Smart Combined Sewer Overflows: Efficient optimisation is achieved through intelligent management systems.

Source: greatlakes.org



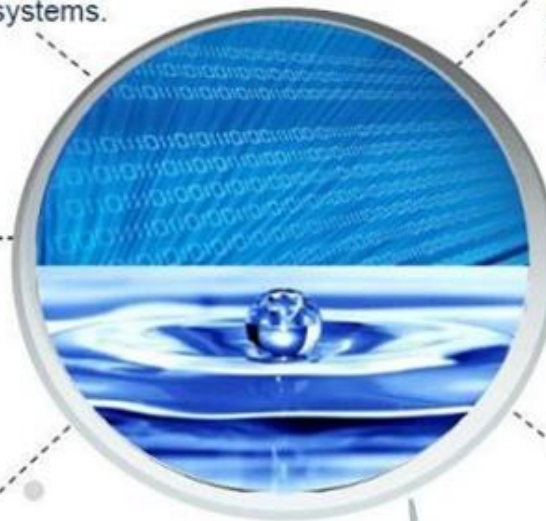
Smart Ultrapure Water: A series of sensors can ensure high water quality and monitor conditions in the system.

Source: organo.co.jp



Smart Water Supply Management: Water resources and environment can be managed to ensure sufficient supplies and quality.

Source: treehugger.com



Smart Irrigation and Agriculture: Commercial uses of water can be optimised to ensure sustainable use.



Source: agreenstarlandscape.com

Smart Wastewater Management: Wastewater can be managed to monitor quality and levels.



Source: usa.siemens.com

Smart Water Distribution Management: Water in utility grids can be monitored to optimise distribution and asset management.

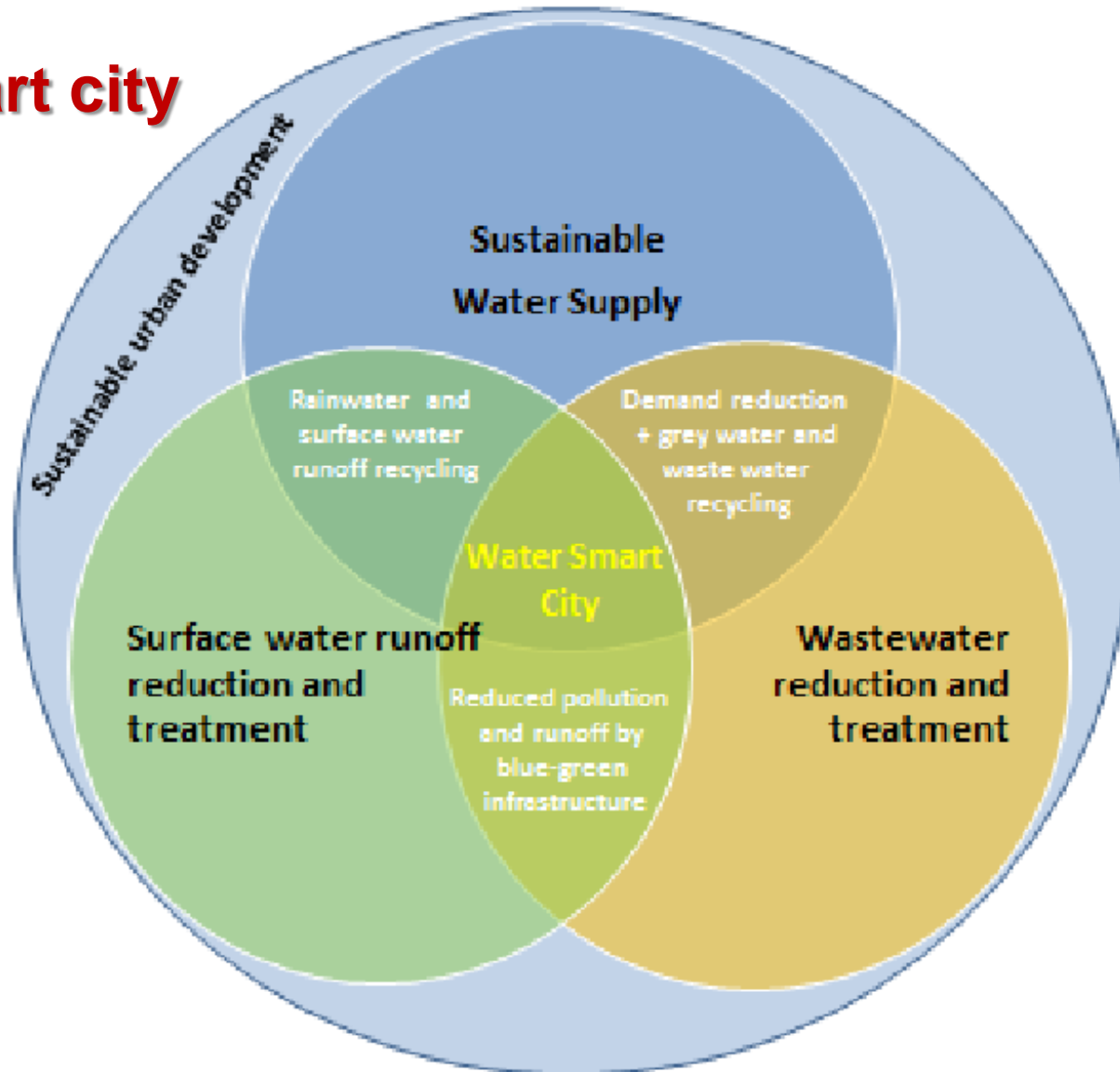


Source: precisionmeters.co.za

Source: Google Images



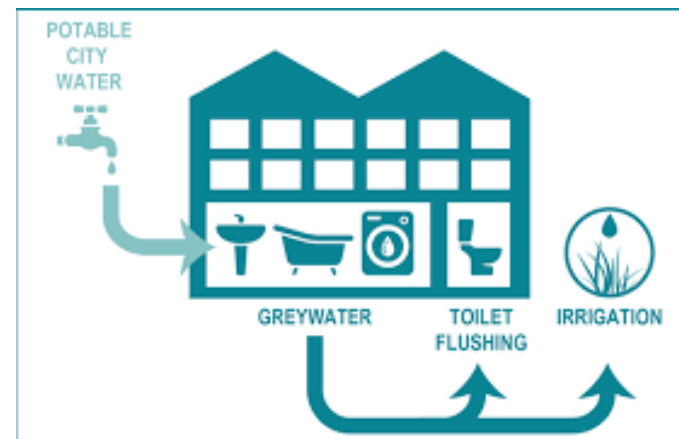
Water smart city





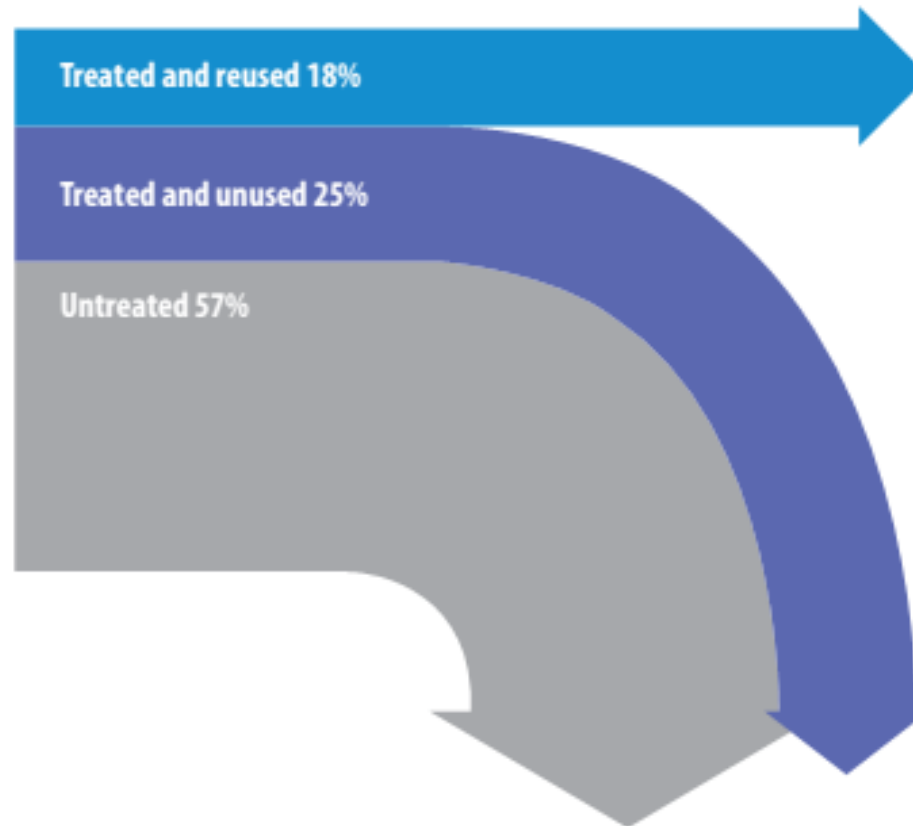
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Share of Collected Wastewater That Is Untreated, Treated, and Reused in Irrigation, Middle East and North Africa





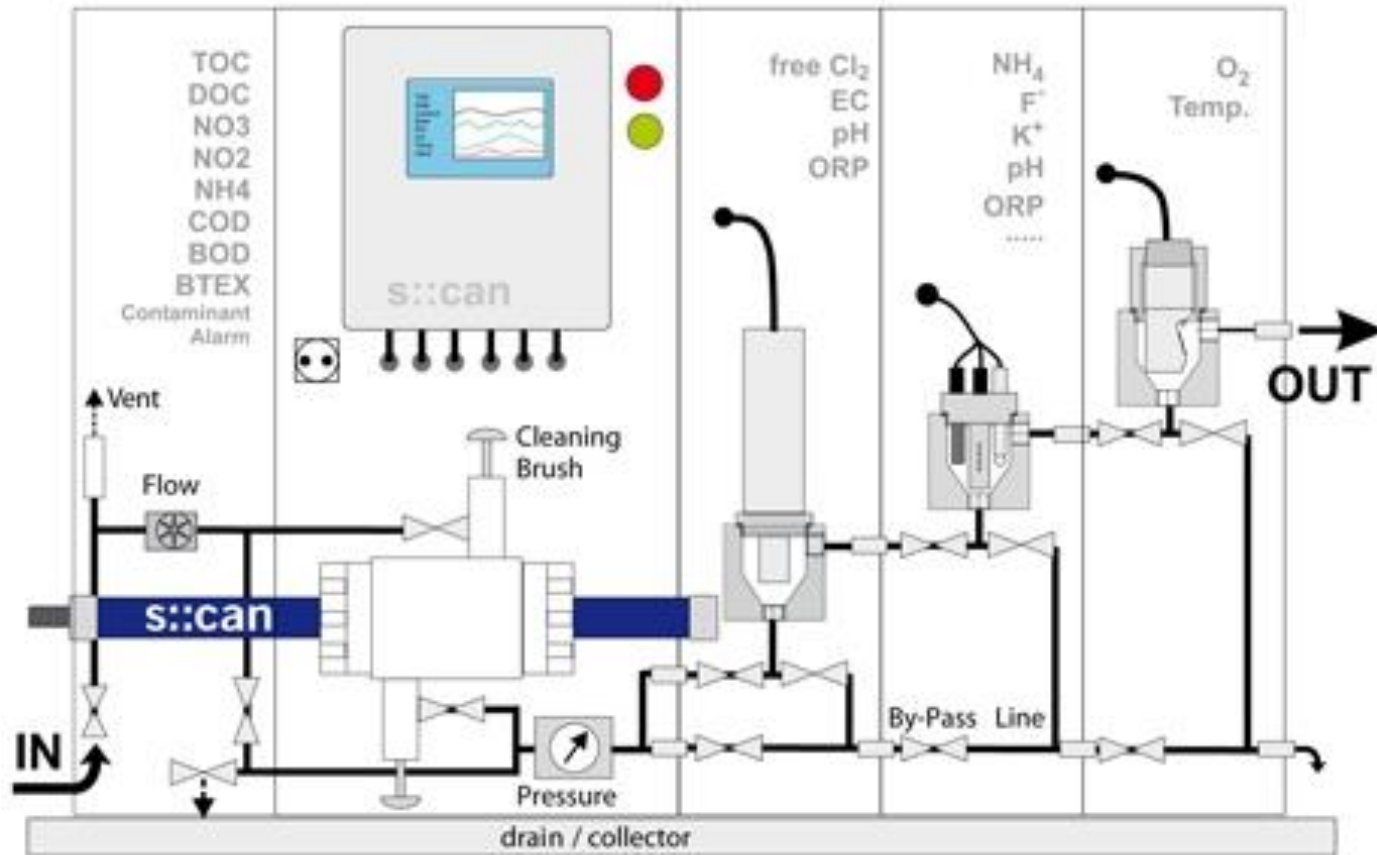
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Ottawa's "Sewergate"



SWM Application: Water quality monitoring



Real-time UV-vis spectra monitoring

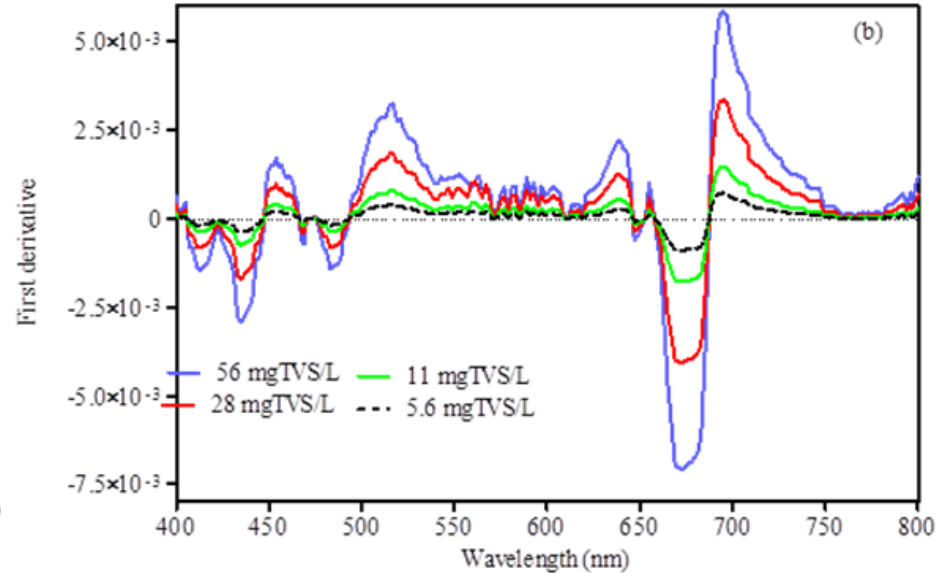
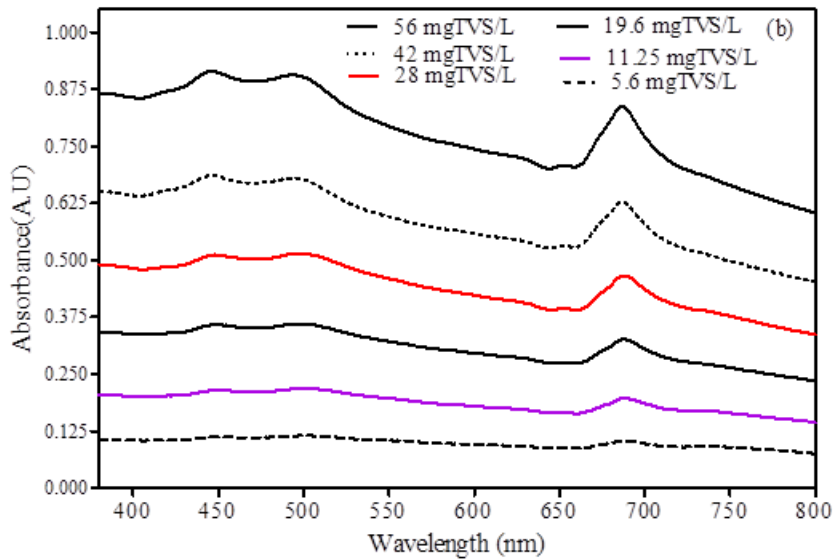


**Real Tech Inc.
(Whitby, ON)**

- UV254
- DOC
- BOD
- COD
- TSS
- Nitrate and nitrite
- Colour
- Algae?

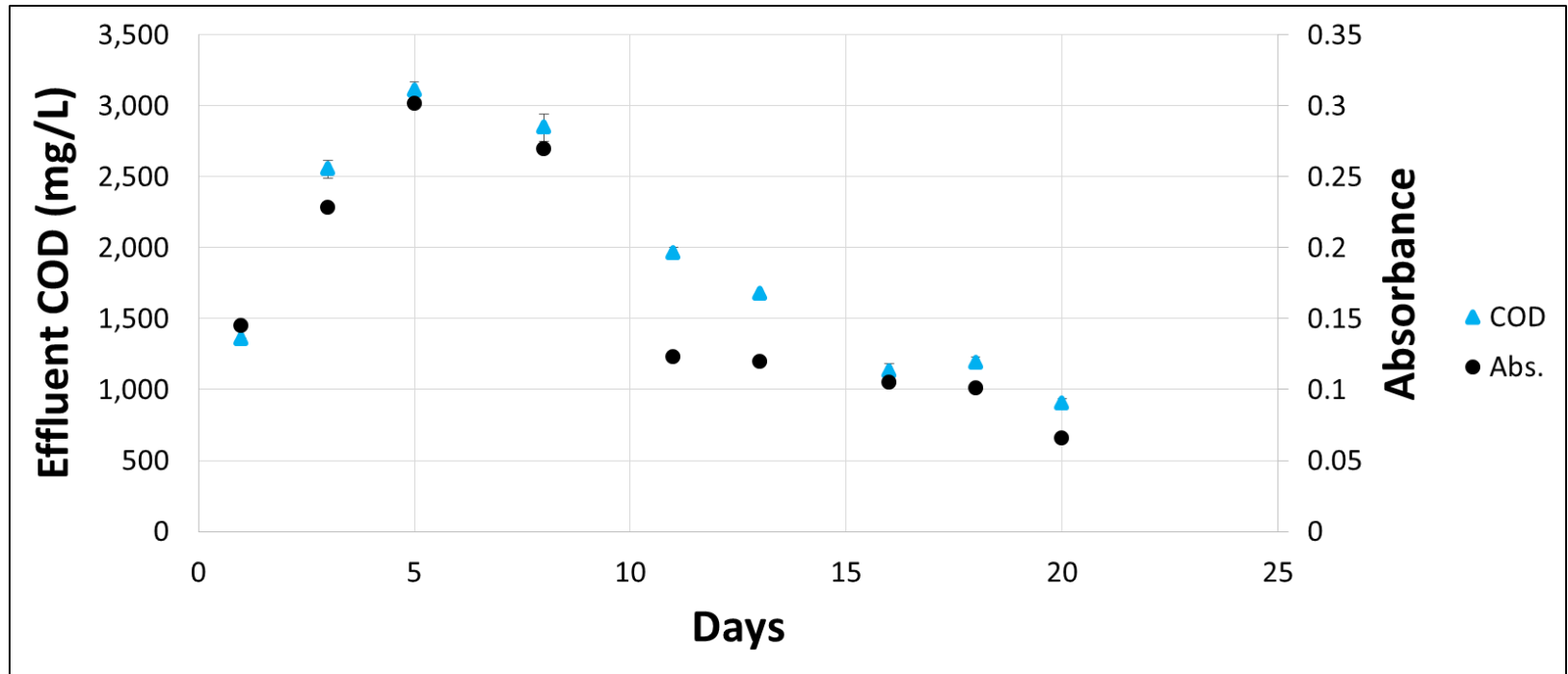


Real-time monitoring of cyanobacteria (patent pending)

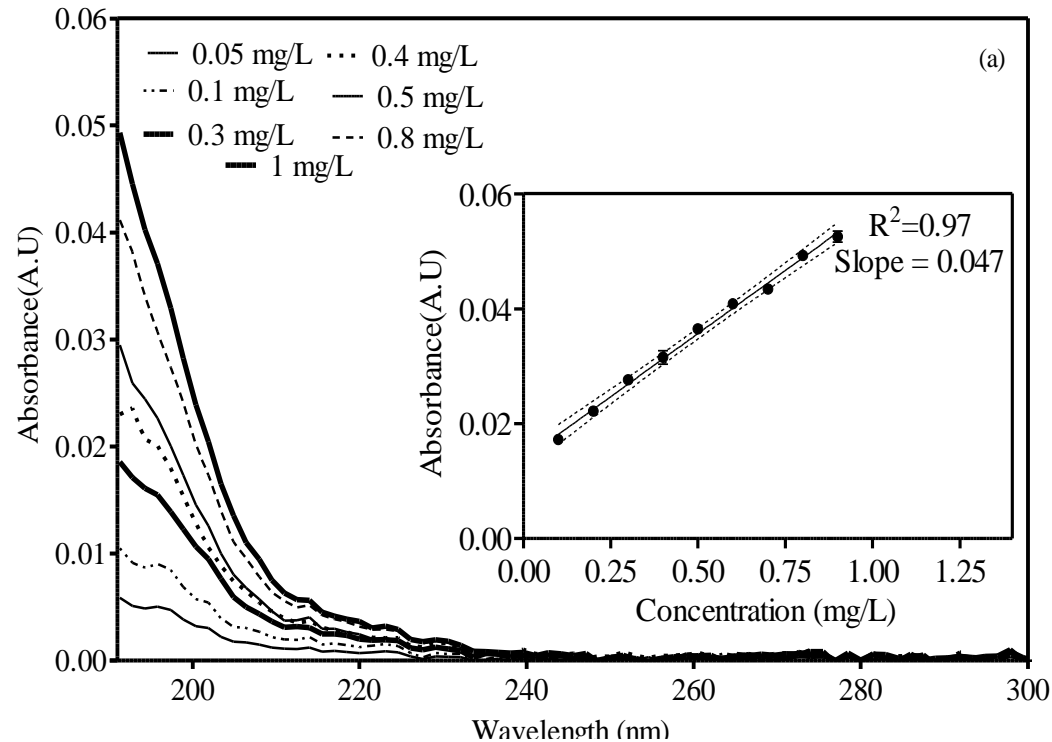


SWM Application: Process optimization

Real-time monitoring of sludge digestion



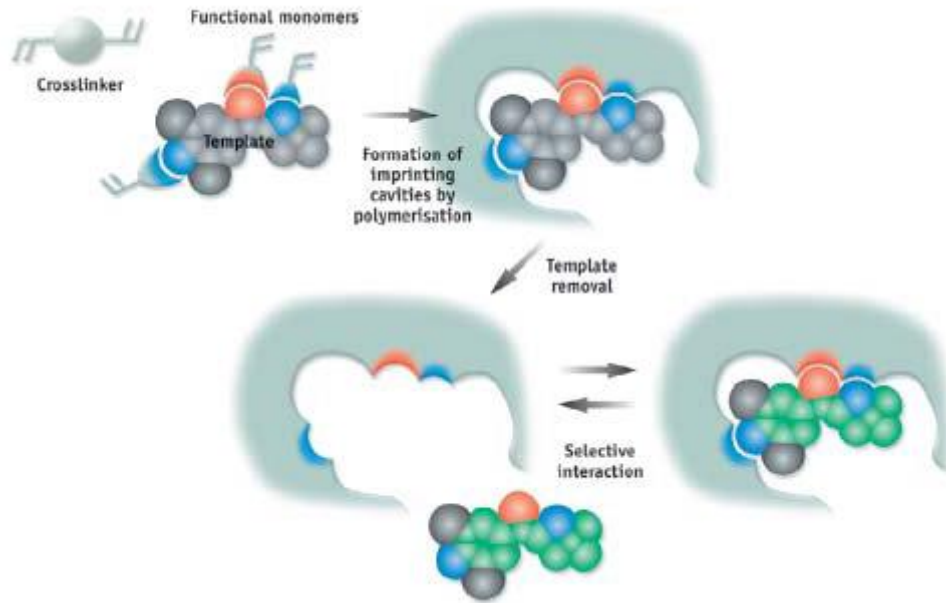
Real-time monitoring of polymer dose



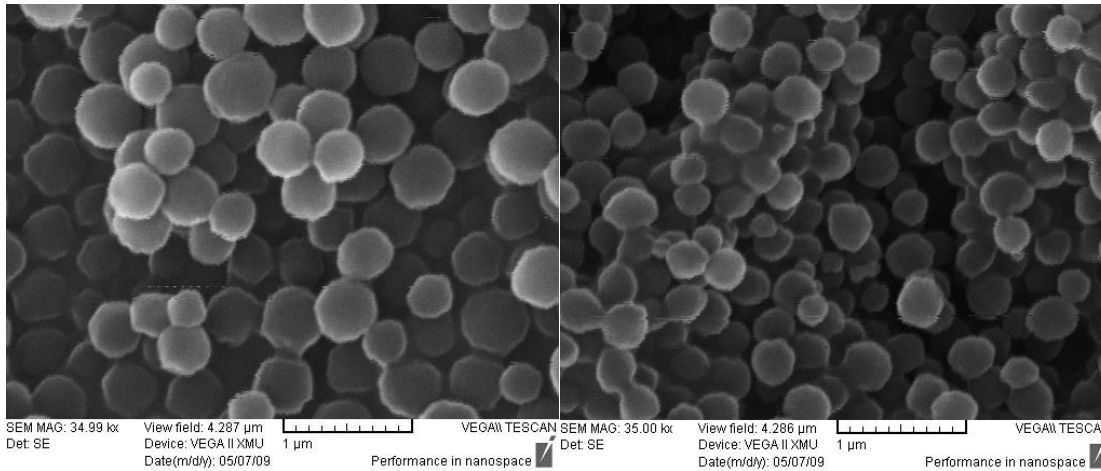
Polymer concentration 0.05-1 mg/L

AlMomani and Ormechi, 2014a





(Widstrand *et al*, 2006)



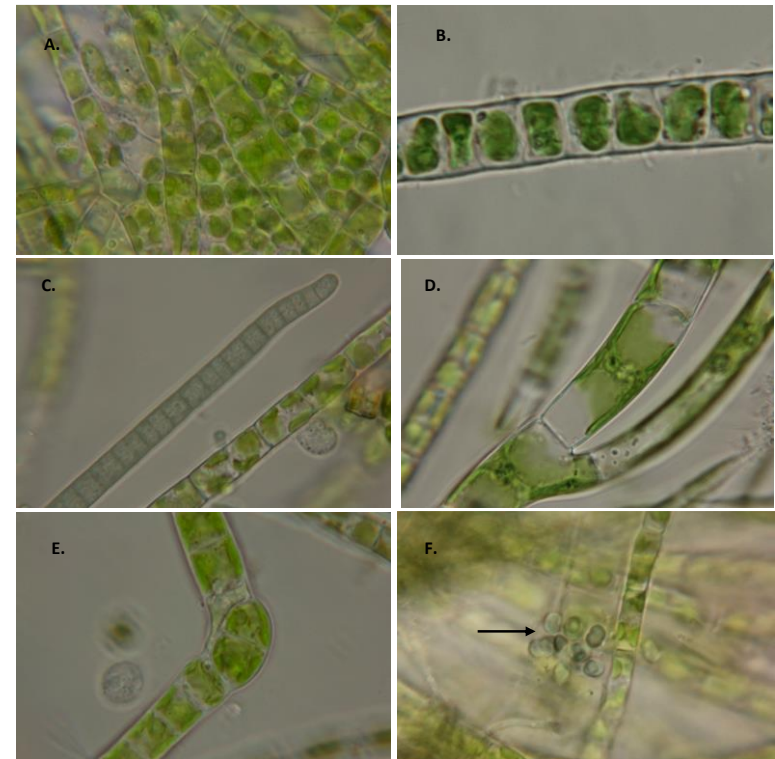
Functional monomer =
MAA
Cross-linker = EGDMA
Template = E2
Size range = 200-600 nm

MIP

NIP

SWM Application: Green treatment technologies

Microalgae treatment


20 °C

Parameter	Primary			Secondary			Centrate		
	C.V.	N.O.	Mixed	C.V.	N.O.	Mixed	C.V.	N.O.	Mixed
COD	40.1	40.1	64.9	49.1	42.4	70.3	61.1	65.7	69.3
Total Nitrogen	60.2	50.7	63.2	55.9	56.8	67.3	33.6	61.6	80.8
Total Phosphorus	34.8	32.4	70.0	11.5	5.67	30.8	25.8	19.8	50

8 °C

Parameter	Primary			Secondary			Centrate		
	C.V.	N.O.	Mixed	C.V.	N.O.	Mixed	C.V.	N.O.	Mixed
COD	20.9	38.3	41.0	35.6	31.8	38.8	35.7	31.3	32.3
Total Nitrogen	30.5	14.1	36.1	44.0	24.0	49.6	34.1	31.0	42.0
Total Phosphorus	16.0	9.5	19.4	9.6	5.7	16.9	13.5	6.5	17.0

Different species identified in wastewater cultivated with mixed algal culture: (A) Tribonema and Chlorella, (B) Ulothrix, (C) Oscillatoria, (D) Stigeoclonium, (E) Tribonema, (F) Aphanocapsa



Conclusions: Closing the urban water cycle





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Research, student exchange, training and more!

Global Water Institute

www.carleton.ca/gwi

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Thank you!