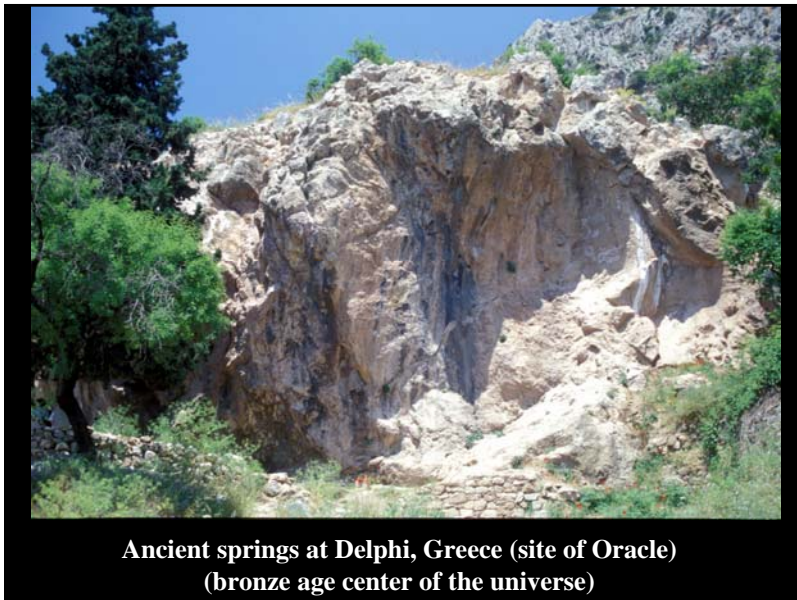
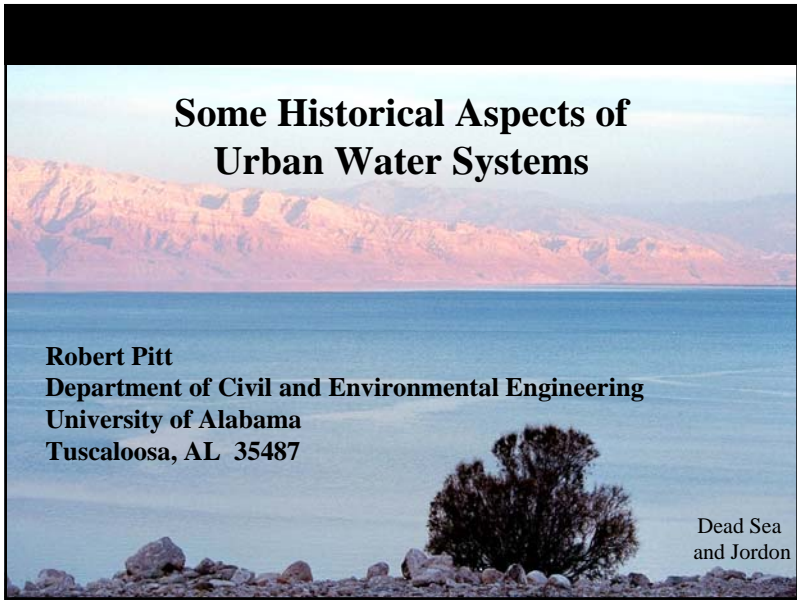


Some Historical Aspects of Urban Water Systems

Robert Pitt
Department of Civil and Environmental Engineering
University of Alabama
Tuscaloosa, AL 35487

Dead Sea and Jordan



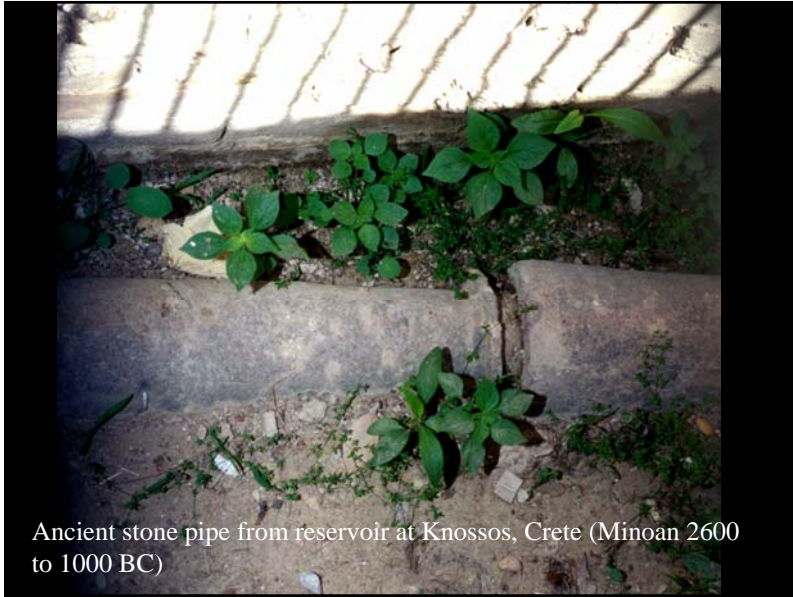
Ancient springs at Delphi, Greece (site of Oracle)
(bronze age center of the universe)



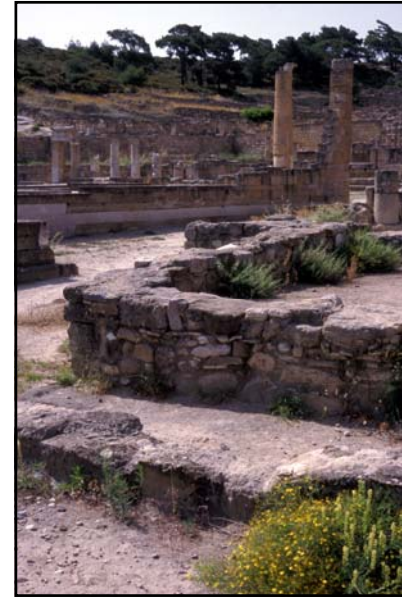
Modern springs at Delphi, Greece



Ancient temple drains at Knossos, Crete (Minoan 2600 to 1000 BC)



Ancient stone pipe from reservoir at Knossos, Crete (Minoan 2600 to 1000 BC)



Kamiros, Rhodes (ancient Greece, 7th century BC)



Ancient clay pipe at Kamiros, Rhodes (ancient Greece, 7th century BC)



Ancient temple site at top of hill that had roof runoff cistern, Kamiros, Rhodes (ancient Greece, 7th century BC)



Cistern tank, Kamiros,
Rhodes (ancient Greece,
7th century BC)



Steps alongside cistern,
Kamiros, Rhodes (ancient
Greece)



The Agora, Athens, Greece (from the Acropolis to modern Athens)
(1st to 4th century BC)



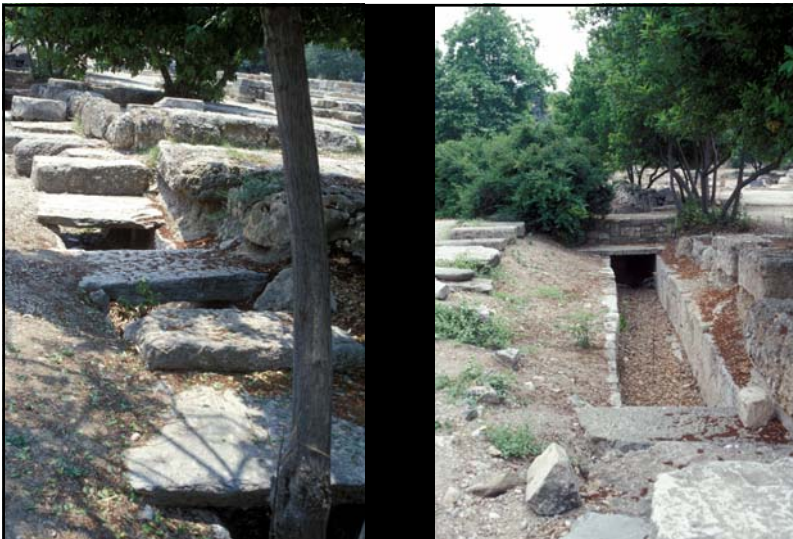
The Agora, Athens, Greece



The Agora, Athens, Greece



Storm drainage channels at the Agora, Athens, Greece



Storm drainage channels at the Agora, Athens, Greece



Storm drainage channels at the Agora, Athens, Greece



Storm drainage channels at the Agora, Athens, Greece



House drain at the Agora, Athens, Greece



Waterwheel at the Agora, Athens, Greece



Child potty, ancient Greece
(Agora Museum)



Pipe at Pompeii, Italy (before 79 AD)

J. Harper photo



Roof drain at Pompeii, Italy
(destroyed Aug 24-26, 79
A.D.)

J. Harper photo



Water storage jugs at Pompeii, Italy (prior to 79 AD)

J. Harper photo



Impluvium (indoor pool and
cistern for rain water storage),
Pompeii, Italy (before 79 AD)

J. Harper photo



Swimming pool at the Baths, Pompeii, Italy (prior to 79 AD)

J. Harper photo



Roman community toilet, Athens, Greece (100 BC)



Coliseum sewage ditch, Rome (completed in 80 AD)

J. Harper photo



Coliseum sewage ditch, Rome

J. Harper photo



Ancient gutter still in use,
Rome (about 100 AD)

J. Harper photo



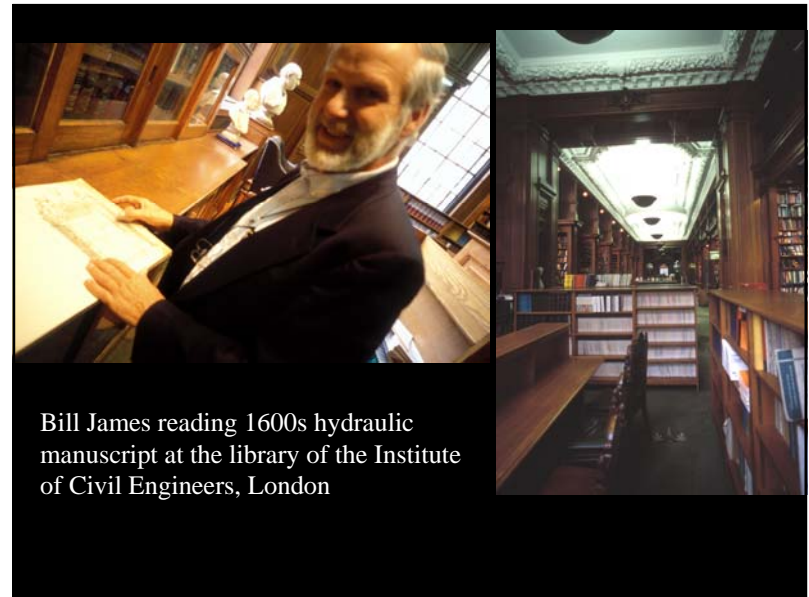
Excavation of ancient Roman pipes, Rome (about 100 AD)

J. Harper photo



Excavation of ancient Roman pipes, Rome (about 100 AD)

J. Harper photo



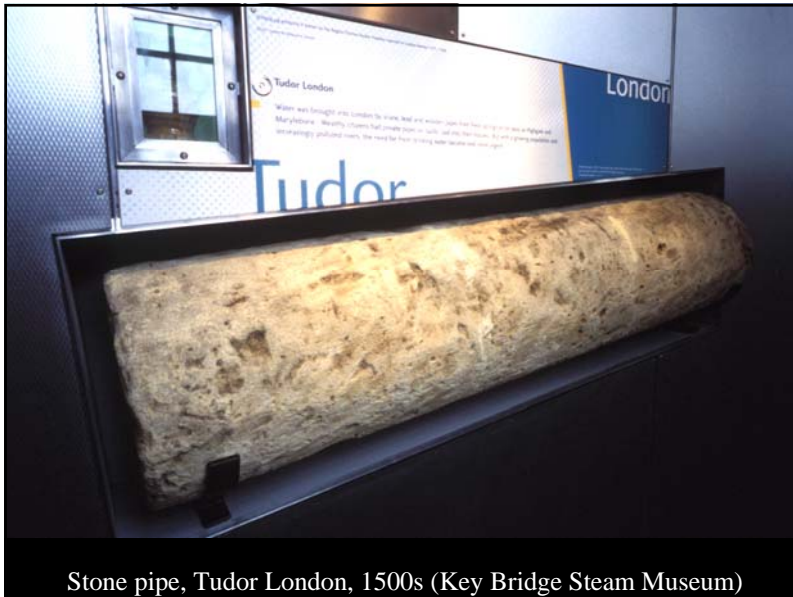
Bill James reading 1600s hydraulic
manuscript at the library of the Institute
of Civil Engineers, London



Clay pipe, Roman London, 43-410 AD (Key Bridge Steam Museum)



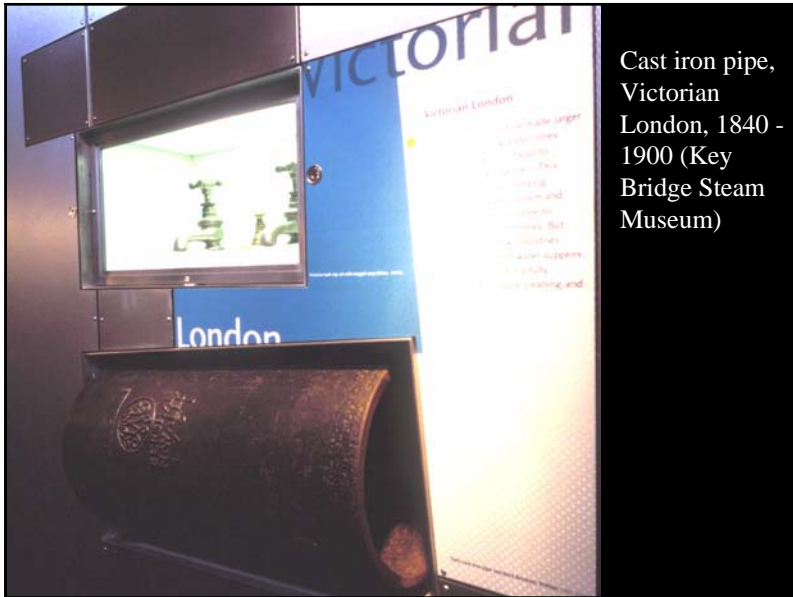
Lead pipe, Medieval London, 1000 to 1400 (Key Bridge Steam Museum)



Stone pipe, Tudor London, 1500s (Key Bridge Steam Museum)



Wood log pipe, Georgian London, 1710 - 1830 (Key Bridge Steam Museum)



Cast iron pipe, Victorian London, 1840 - 1900 (Key Bridge Steam Museum)



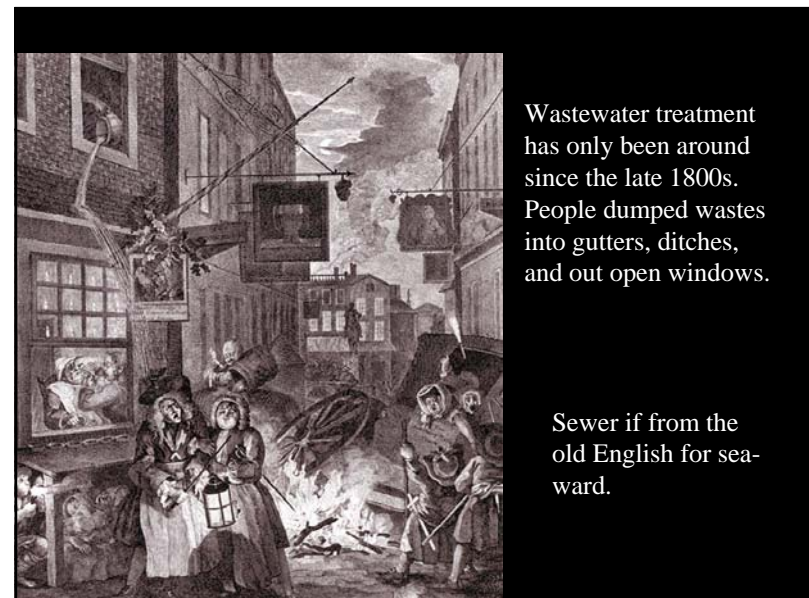
Wooden water pipe, Seattle, WA (Underground Seattle Museum)



Hamilton, Ontario, Historical Pump House

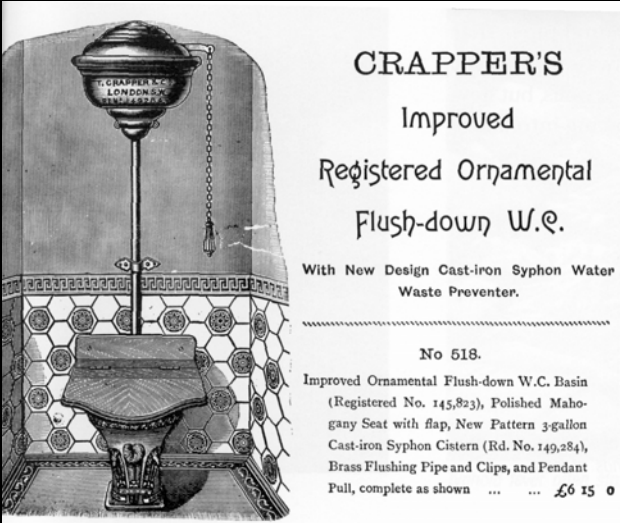
The Waterworks becomes a Museum

The Last Days of the Pump House



Wastewater treatment has only been around since the late 1800s. People dumped wastes into gutters, ditches, and out open windows.

Sewer if from the old English for seaward.



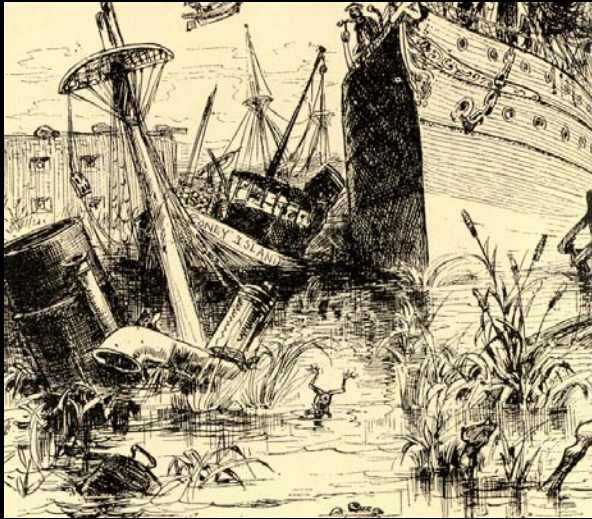
CRAPPER'S
Improved
Registered Ornamental
Flush-down W.C.

With New Design Cast-iron Syphon Water
Waste Preventer.

No 518.
Improved Ornamental Flush-down W.C. Basin
(Registered No. 145,823), Polished Mahogany Seat with flap, New Pattern 3-gallon Cast-iron Syphon Cistern (Rd. No. 149,284), Brass Flushing Pipe and Clips, and Pendant
Full, complete as shown ... £6 15 0


More people were able to have a flush toilet, not just the rich. First US treatment plant built in NYC in 1886 to protect Coney Island beaches from vast increases in wastewater volume.

Polluted New York Harbor in 1883



Coombs and Boucher

Polluted New York Harbor (Coney Island Creek) in 2000

CRAPPER'S
VALVELESS WASTE PREVENTER
NO 514

Thomas Crapper's Toilet Tank and "Valveless Waste Preventer"
(Underground Seattle Museum)

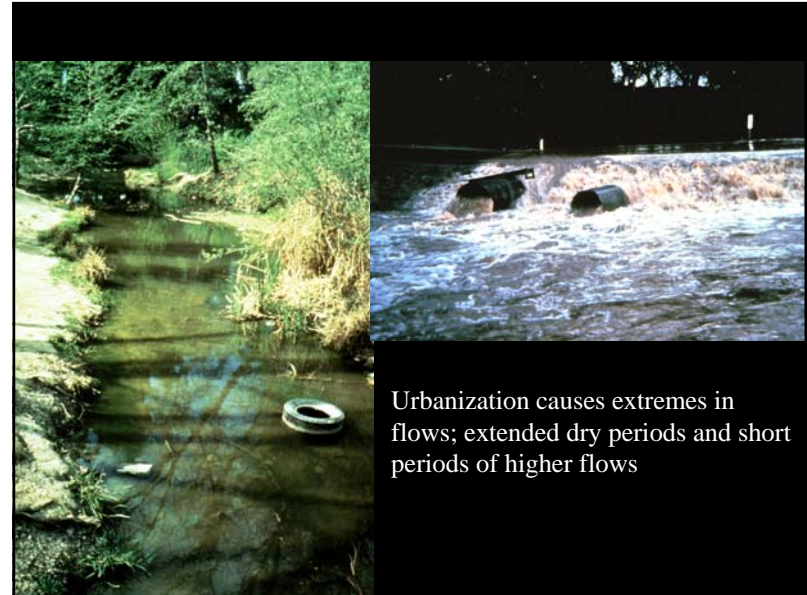


Elevated toilet to keep above hydraulic grade line during high tides, Seattle, WA (Underground Seattle Museum)

After years of a bad sewage system and several fires, Seattle finally decided to build a new sewage system where the streets were raised anywhere from 8 to 36 feet. However, it was years before they actually raised the sidewalks, requiring climbing up a ladder (sometimes 36 feet high) to cross the street and then climbing back down on the other side.

Major Receiving Water Beneficial Uses

- Stormwater Conveyance (flood prevention)
- Recreation (non-water contact) Uses
- Biological Uses (Warm water fishery, aquatic life use, biological integrity, etc.)
- Human Health Related Uses (Swimming, Fishing, and Water Supply)

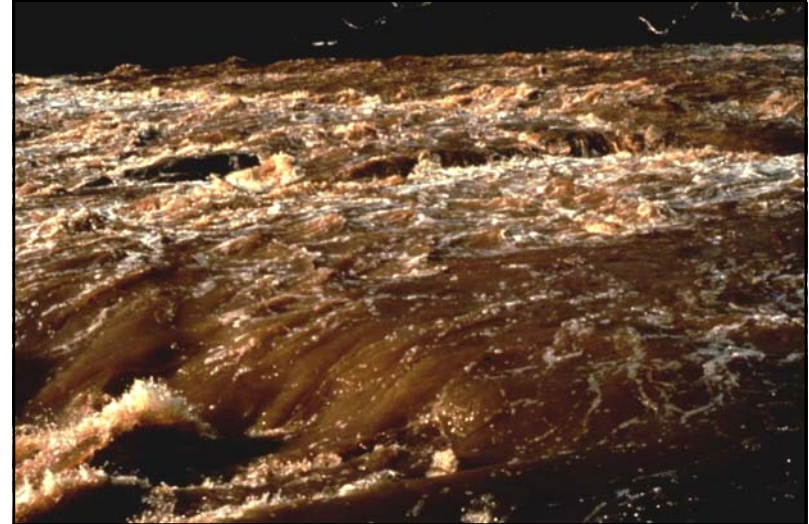


Urbanization causes extremes in flows; extended dry periods and short periods of higher flows

Increased high flows have lead to unusual solutions



Urbanization has also caused increased pollutant discharges



Numerous beach closures at community swimming beaches due to bacteria from urban runoff discharges



WI DNR photo

Beach Closings in the US in 1994

Sanitary Sewer Overflows (SSOs)	584 (43%)
Stormwater Runoff	345 (25%)
Combined Sewer Overflows (CSOs)	194 (14%)
Agricultural Runoff	136 (10%)
Wastewater Treatment Plant Malfunctions	106 (7.8%)

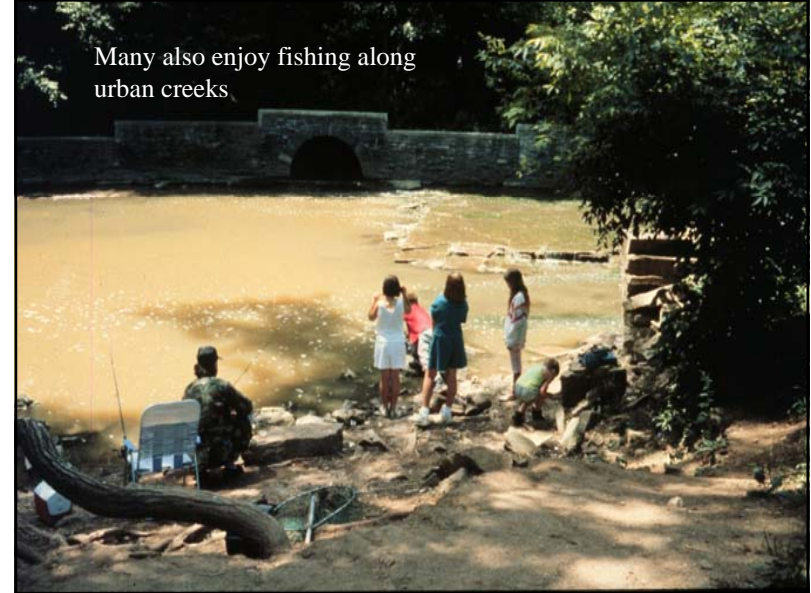
However, kids still play in urban creeks and swim near outfalls



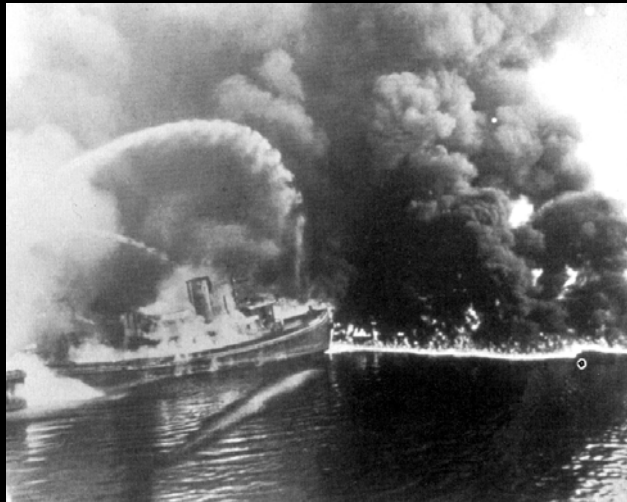
WI DNR photo



Many also enjoy fishing along urban creeks



Cuyahoga River in Cleveland often Caught on Fire Between 1952 and 1969



Fire from 200,000 gallons of spilled gasoline into an urban creek, Bellingham, Washington, 2000.



Sanitary Sewer Overflow, 5-Mile Creek, Birmingham, AL



Continuous, low volume
sanitary sewage leakage
at 5-Mile Creek study area,
Birmingham



Upwelling sewage from broken sewer in backyard, Birmingham



Discharge of sanitary sewage leak into Village Creek, Birmingham



Captured floatable debris from combined sewer outfalls at Brooklyn, NY, study area.



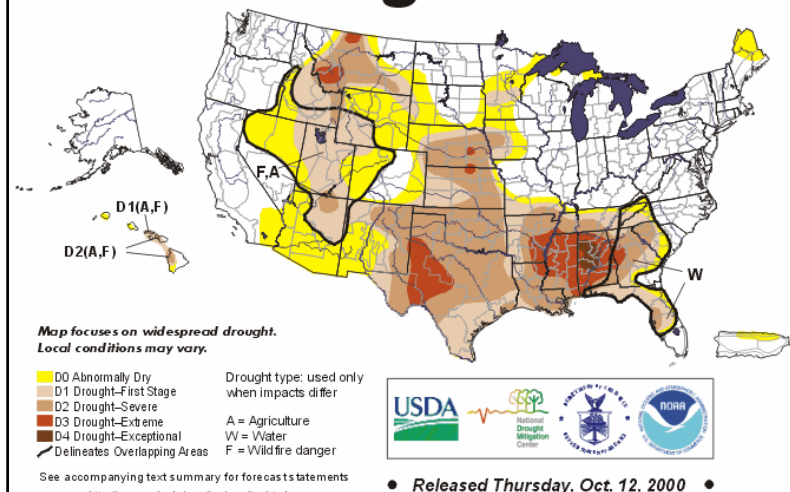
URBAN STREAMS STUDY 1992-93

Bacteria in Lincoln Creek



October 10, 2000 Valid 8 a.m. EDT

U.S. Drought Monitor



"It's a class of customer that stretched our minds about what people can consume."

Randy Chafin
Assistant
general manager
of the Water Works

THE WATER CRISIS

Groups urge
no new water,
sewer hookups

THE WATER CRISIS

Water Works
looks at tapping
other systems

Spray Irrigation of Treated Wastewater at Golf Course

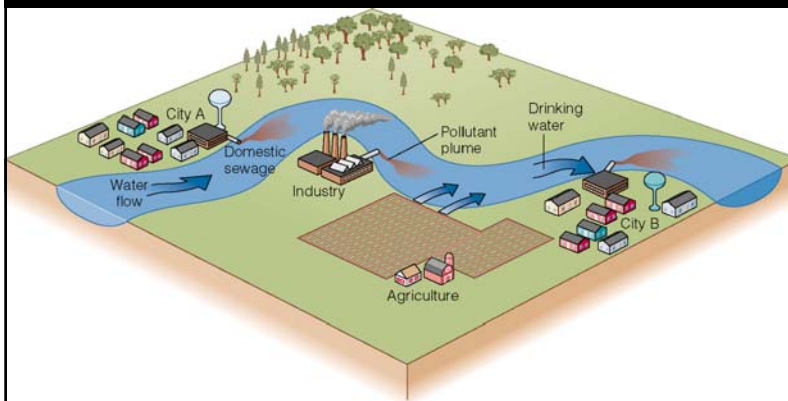


Basic Wastewater Conveyance in Sanitary Condition not Always Achieved



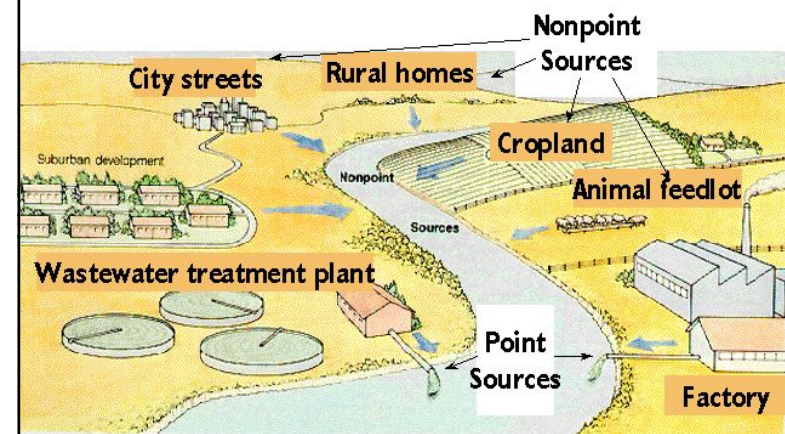
McKinney and Schoch

One City's Wastewater is Another City's Water Supply

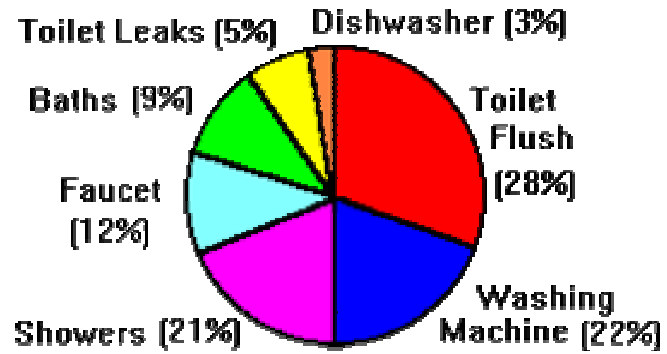


McKinney and Schoch

Point and nonpoint sources



Percent Water Consumption



Aqueduct in Havana, Cuba, 1565



Private Water Delivery in Havana, Cuba, 2003



What is the infrastructure like in developing countries?

What will cities be like in the future?

What type of infrastructure will be used for water and wastes?

Can we continue to use the same systems as we use now?