

Wastewater Reclamation, Recovery and Reuse

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Toilet to Tap? Finding Where the Water Is!

There are no more orange groves in Orange County, California.

Instead, population grows and water is in increasingly short supply. However, there is an ever-increasing flow of *wastewater* (a.k.a., *sewage*).

Now, a \$481m *groundwater replenishment* system employing microfiltration, reverse osmosis and UV-peroxide oxidation is purportedly making wastewater '*as pure as distilled water*'...



Orange County, CA Water District

'Indirect Potable Water Reuse'

70 mgd - Groundwater Replenishment System



\$481 million

When freshwater gets scarce ... utilize 'toilet to tap', a.k.a.

Wastewater Reclamation & Reuse

**California State Department of Health
permits use of reclaimed wastewater for:**

- ☒ **agricultural irrigation of over 20 food crops*,**
- ☒ **landscape parks, playgrounds and golf courses,**
- ☒ **restricted recreational impoundments,**
- ☒ **groundwater recharge to domestic water supply areas**

*Apples, Grapes, Asparagus, Lettuce, Avocados,
Maize, Barley, Peaches, Beans, Peppers, Broccoli,
Pistachios, Cabbage, Plums, Cauliflower, Squash,
Celery, Sugar Beets, Citrus, Wheat



Municipal Water Reuse Markets 2010

Analysis, forecasts
and inventory



Global
Water Intelligence

A Global Water Intelligence publication
www.globalwaterintel.com

Produced in collaboration
with PUB Singapore

Water for All. Clean. Safe. Secure.

“NEW REVENUE STREAM SPRINGS UP “

“WATER REUSE MARKET SET FOR EXPLOSIVE GROWTH”

“We will drink more reclaimed water - indirectly.”

“Ultrafiltration, reverse osmosis and ultraviolet disinfection - have become cheaper and more effective.”

“Recycling water seems as natural as any other recycling.”

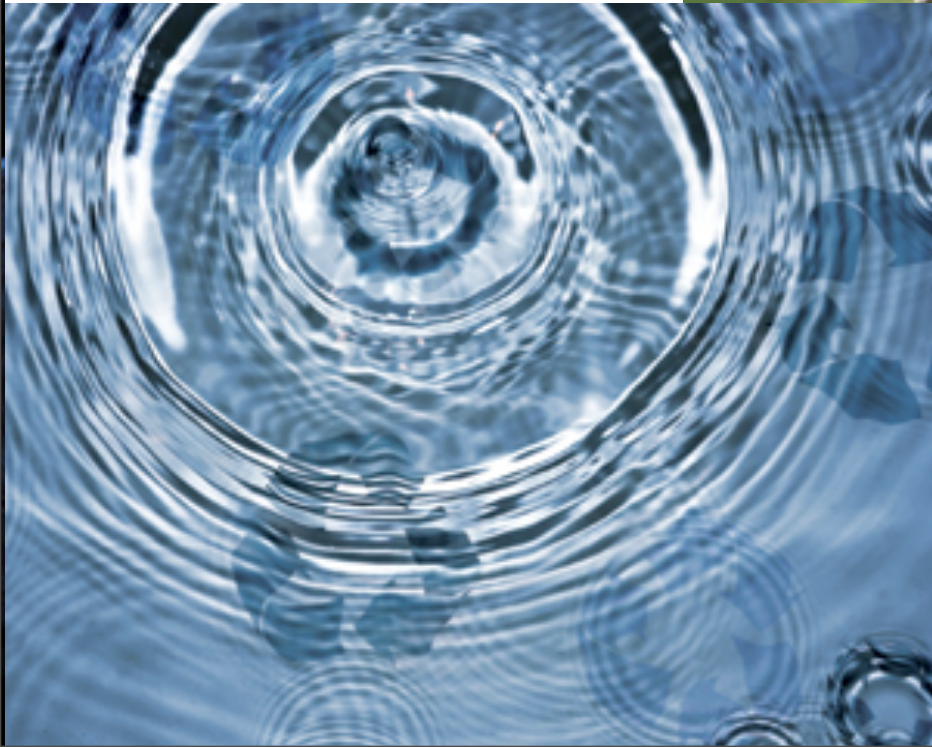
“... water reuse can be an essential part of sustainable cities”.

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Water Reuse will be Beautiful



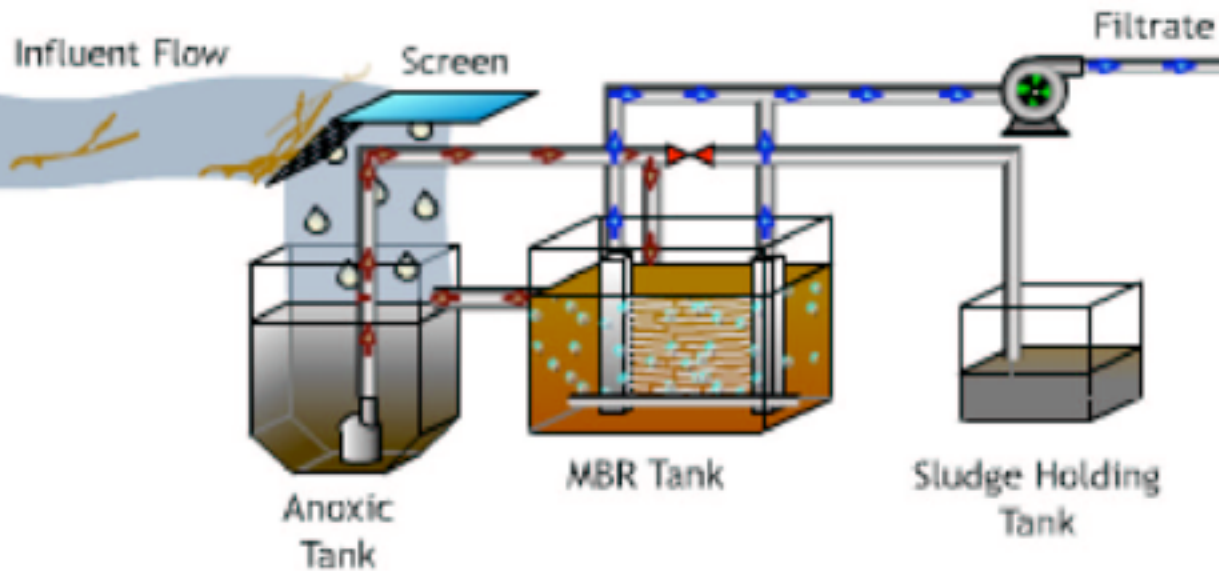
KCMO Symbol



Tapping into Sewers

'Sewer Mining' for 'Brown Gold'

Membrane Bioreactors



Requires Chemical Control of Membrane Fouling

Membrane Module



Sewer Mining?

Padlock your manholes?

Sewage to Membrane Bioreactors (MBR)

membranes immersed into highly concentrated mixed liquor suspended solids

Hydraulic Retention Time: 4-8 hours; 25% conventional footprint

Solids Retention Time: 10- 365 days; 20% conventional sludge yield

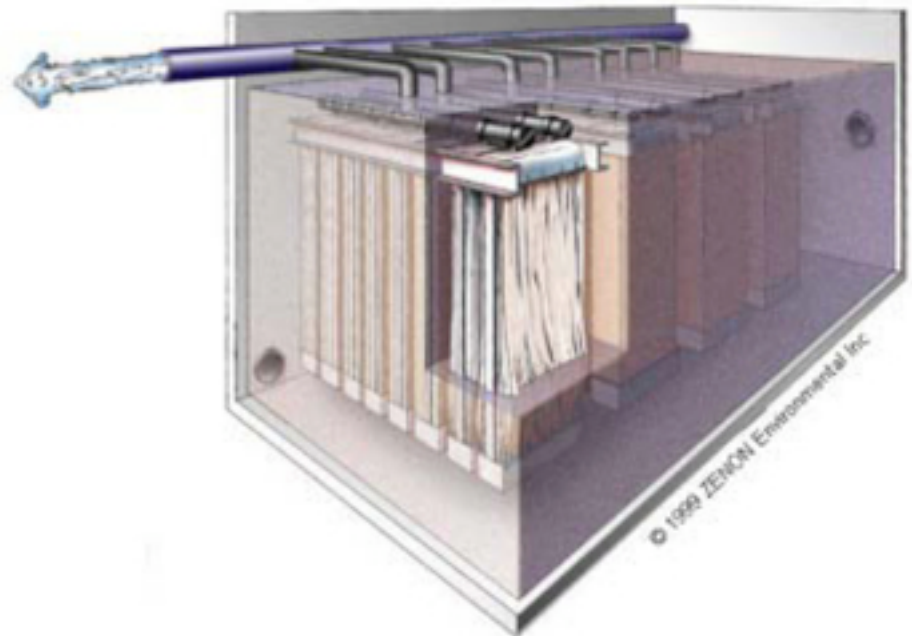
MLSS: 10,000 - 15,000 mg/l

Modular: small scale

Effective organism removals

Removal of nutrients

Reuse of product water



Operational Issues

Membrane Bioreactors (MBR)

Fine Screening (1 mm) required; disposal of untreated waste

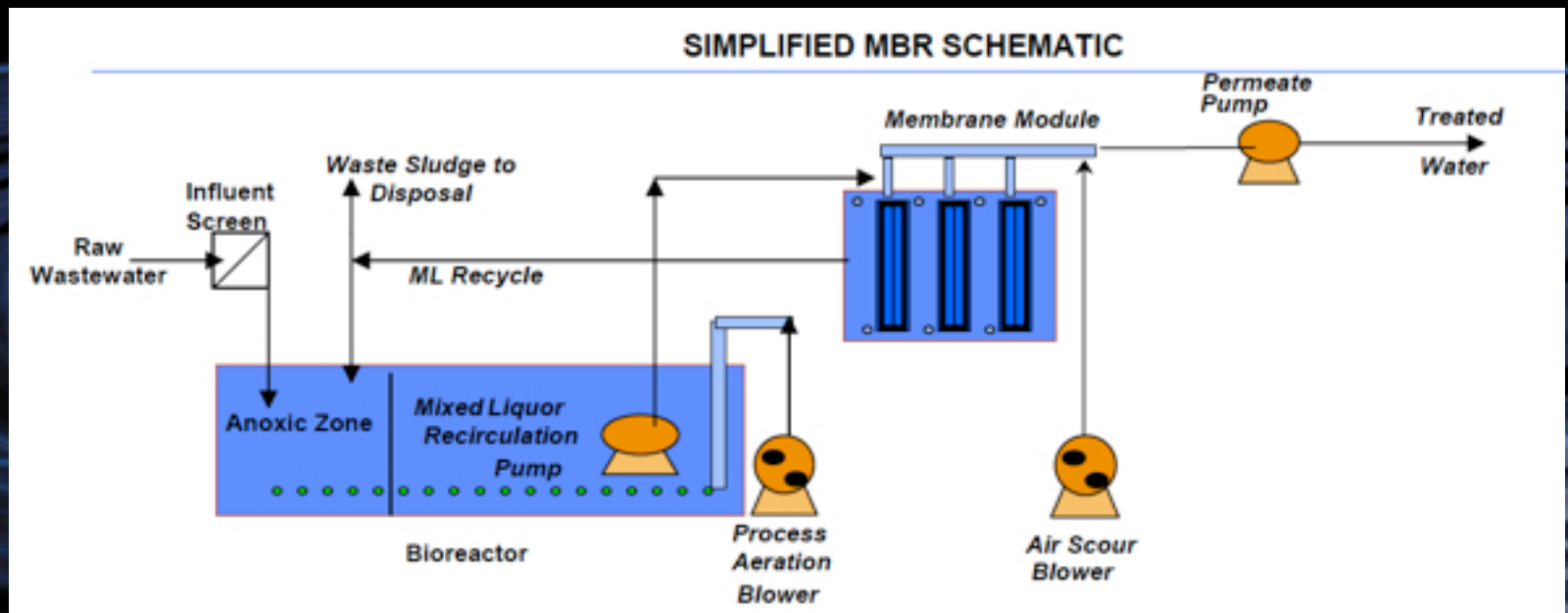
Fouling results in low membrane flux rates; large membrane surfaces

Air Scour, MLSS recirculation: high energy consumption

Large Equalization Tank Volume: to offset low peak flow tolerance

Low Oxygen Transfer Efficiency due to high MLSS

Membrane Replacement Frequency and Costs



Where is Reclamation Occurring?

CA, FL, TX, AZ, NM, NE, CO, GA, WA, VA, NY, MA

Orange County Water District

Central/West Basin

Metropolitan Water District

San Jose

Los Angeles Co Sanit District

San Diego County

Irvine Ranch

Dublin San Ramon

East Bay Municipal Utility District

Orlando

Scottsdale

Phoenix

San Antonio

El Paso

Tarrant Regional

St. Petersburg

Pinellas County

King County (WA)

Austin

Santa Rosa

UOSA (VA)

Southwestern Nevada Water Authority/Las Vegas

Valley Water District



Foxboro, MA

0.25 mgd used for toilet flushing

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