CONTINUING STAKEHOLDER PARTICIPATION: TECHNICAL SUPPORT, ADVOCACY, RESOURCES, RESEARCH AND FUNDING

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Challenges for Optimization of Water Reuse

The Triple Bottom Line

1. Economics - life cycle costs

2. Environmental aspects - energy consumption the “carbon footprint”, water quality, and environmental protection

3. Societal views - public perception
Safety of reclaimed water
- Quality regulated by USEPA and ADEQ
- Different water quality classes of reclaimed water (C, B, B+, A, A+)

Safety of infrastructure
- Identified by the color purple
- Dye tests to ensure there is no cross-connection between potable and reclaimed systems

Public Perception
- ‘Yuck’ Factor
- Education is key
- Prevent Toilet to Tap headlines

Is it clean enough?
- Pharmaceuticals, personal care products, EDC’s, microorganisms etc.
- Questions remain about ingestion posing health concern for humans
Waste Water Treatment Facilities treat water to extremely high standards.

The majority of Recycled water produced in Arizona is considered A+ grade quality (AZ).

- Regulation and Permitting
- Education

- Perception of Terms
- Support for Potential Uses of Reclaimed Water
- Concerns about Using Reclaimed Water
- Support of Implementation Strategies
- “What would reduce your concerns about reclaimed water?”
TERMINOLOGY

Positive
- “water re-use”
- “recycled water”
- “re-purified water”
- “reclaimed water”

Negative
- “effluent”
- “tertiary treated wastewater”
- “wastewater”
- “toilet to tap”
Arizona residents generally support most potential uses of reclaimed water.

- for **cooling towers** in power plants
- **fire hydrants** for fire fighting
- to control **dust** on roads and at construction sites
- for **watering the grass** at cemeteries
- for **watering the grass** at golf courses
- for watering **non-edible crops**, such as cotton
- for **toilet flushing** in public or commercial buildings
- to sustain **cottonwood trees** and other plants along rivers
for watering **household yards**
for watering **public parks and schoolyards**
for watering **orchards**
to restore **habitat** for wildlife
for watering livestock **feed crops**, such as hay or alfalfa
for **snowmaking** at ski areas
to increase **stream flows** to support recreational activities like fishing and camping
to replenish **groundwater** supplies

- for watering **vegetable crops**
76% of Arizonans support using “consumer incentives for using reclaimed water.”

Over two-thirds of Arizonans (67%) support “increasing water or sewer rates to treat water to higher standards.”
Support/Opposition for potential uses of reclaimed water treated to higher standards

<table>
<thead>
<tr>
<th>Activity</th>
<th>Strongly support</th>
<th>Somewhat support</th>
<th>Unsure</th>
<th>Somewhat oppose</th>
<th>Strongly oppose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household cleaning</td>
<td>39%</td>
<td>26%</td>
<td>4%</td>
<td>12%</td>
<td>13%</td>
</tr>
<tr>
<td>Laundry</td>
<td>36%</td>
<td>35%</td>
<td>3%</td>
<td>10%</td>
<td>17%</td>
</tr>
<tr>
<td>Bathing</td>
<td>25%</td>
<td>26%</td>
<td>7%</td>
<td>16%</td>
<td>27%</td>
</tr>
<tr>
<td>Cooking</td>
<td>22%</td>
<td>19%</td>
<td>5%</td>
<td>14%</td>
<td>39%</td>
</tr>
<tr>
<td>Drinking</td>
<td>16%</td>
<td>19%</td>
<td>6%</td>
<td>15%</td>
<td>45%</td>
</tr>
</tbody>
</table>
“HOW WILLING WOULD YOU BE TO DRINK PURIFIED WATER MADE FROM ADVANCED TREATED RECYCLED WATER?”

a. Yes, I’m willing

b. Somewhat willing

d. I don’t know/NA

c. No, not willing
“BEFORE TODAY, DID YOU THINK THAT IT WAS POSSIBLE TO FURTHER TREAT RECYCLED WATER USED FOR IRRIGATION TO MAKE THE WATER PURE AND SAFE FOR DRINKING?”

a. Yes

b. No

c. Don’t know/NA
“OTHER” OPEN-ENDED RESPONSES:
“WHAT ELSE WOULD REDUCE YOUR CONCERNS ABOUT RECLAIMED WATER?”

“The more that it is used the more comfortable I will be with it”

“If my doctor told me it was safe”

“I would like to take a tour of the treatment plant and see for myself and understand that it is safe”

“Information from a known/trusted source”
How do we facilitate change and combat community concerns while encouraging positive responsiveness in society?
**RISK AND TRUST**

- High correlations between **Risk** and **Trust**

- If one is able to exert change in people’s **risk** and **trust perceptions**, one might also promote change in variables otherwise less receptive to change.
WHO DO PEOPLE TRUST

- University Faculty
- Medical Professional (Doctors and Nurses)
- Pharmacist
- Medical Scientists
- Industry Leaders
- News Media
- Elected Officials
Public trust of information from scientists is higher than for industry leaders, news media, elected officials.

% of U.S. adults who say that they trust each of these groups a lot to give full and accurate information on these topics.

- Medical scientists: 55%
- Pharmaceutical industry leaders: 13%
- Holistic/alternative health groups: 9%
- The news media: 8%
- Elected officials: 6%

San Diego Physician

You Must Register By January 1, 2016

"Physicians United for a Healthy San Diego"
SO YOUR PATIENT ASKS ABOUT TOILET TO TAP...

by James Beaubeaux, SDCMS COO and CFO
WHAT NOT TO DO...
Potential Contaminants

Chemical origins:
- Pharmaceuticals
- Industrial chemicals
- Natural chemicals
- Transformation products
- Anions
- Cations
- Metals

Microbial origins:
- Bacteria
- Viruses
- Protozoa
- Helminths

Chemical compounds:
- Pesticides
- Personal care products
- Household chemicals
<table>
<thead>
<tr>
<th>Bacterial Pathogen</th>
<th>Disease</th>
<th># in Raw WW (per liter)</th>
<th>Method of Quantification</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Aeromonas hydrophila</em></td>
<td>Gastroenteritis, peritonitis, meningitis, cellulitis, pneumonia, bacteremia</td>
<td>Up to $10^3$</td>
<td>Cultural</td>
</tr>
<tr>
<td><em>Atypical mycobacteria</em></td>
<td>Respiratory illness (hypersensitivity pneumonitis)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><em>Campylobacter</em></td>
<td>Gastroenteritis, reactive arthritis, Guillain-Barré syndrome</td>
<td>Up to $10^4$</td>
<td>Cultural</td>
</tr>
<tr>
<td><em>Escherichia coli</em></td>
<td>Gastroenteritis and septicemia, hemolytic uremic syndrome (HUS)</td>
<td>Up to $10^7$</td>
<td>Cultural</td>
</tr>
<tr>
<td><em>Helicobacter</em></td>
<td>Chronic gastritis, ulcers, gastric cancer</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><em>Legionella</em></td>
<td>Respiratory illness (pneumonia, Pontiac fever)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><em>Pseudomonas</em></td>
<td>Skin, eye, ear infections</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><em>Salmonella</em></td>
<td>Salmonellosis, gastroenteritis (diarrhea, vomiting, fever), reactive arthritis, typhoid fever</td>
<td>Up to $10^5$</td>
<td>Cultural</td>
</tr>
<tr>
<td><em>Shigella</em></td>
<td>Shigellosis (bacillary dysentery)</td>
<td>Up to $10^4$</td>
<td>Cultural</td>
</tr>
<tr>
<td><em>Staphylococcus</em></td>
<td>Skin, eye, ear infections, septicemia</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><em>Vibrio cholera</em></td>
<td>Cholera</td>
<td>Up to $10^5$</td>
<td>Cultural</td>
</tr>
</tbody>
</table>
# Example Pathogen Log Reduction Credits

<table>
<thead>
<tr>
<th>Process</th>
<th>Monitoring</th>
<th>Log Reduction Credits</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary treatment</td>
<td>Study needed</td>
<td>0 - 1.9</td>
<td>0 - 0.8</td>
</tr>
<tr>
<td>MF or UF</td>
<td>Daily PDT</td>
<td>0</td>
<td>4.0</td>
</tr>
<tr>
<td>RO</td>
<td>Online EC</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>UV-AOP</td>
<td>Intensity sensors</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Free chlorine</td>
<td>Online Cl₂</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>13.5</strong></td>
<td><strong>14.5</strong></td>
</tr>
</tbody>
</table>
WHAT WE SHOULD DO...
We forget that the water cycle and the life cycle are one.

— Jacques Yves Cousteau —
Public Health Protection is the number one priority!

Where does your water come from?

How do we know that it is safe?

Trusting in technology (dish washer, cell phones, vaccines, etc.)
THE HYDROLOGIC (WATER) CYCLE WITH HUMAN INFLUENCE

Graphic credit: www.healthywaterways.org
NEXT GENERATION URBAN WATER CYCLE
ADVANCED TECHNOLOGY REPLACES NATURE TO PRODUCE POTABLE WATER

Advanced Water Treatment Plant

Home & Business

Wastewater Treatment Plant
Why is microbial control important for potable reuse?

• **What?** For PR, public health protection requires that pathogens in wastewater be removed or inactivated.

• **Why?** Pathogens in recycled water include bacteria, viruses, and protozoan parasites. Pathogenic microorganisms present significant acute risks to the consumer and are the most important design and operating concern for potable reuse systems.
ADVANCED TECHNOLOGY

1. Ultrafiltration
Membranes remove bacteria, protozoan and some trace pathogen.

2. Reverse Osmosis
Membranes remove salt, organics, trace pollutants and remaining pathogens.

3. Disinfection/Advanced Oxidation
Removes trace pollutants and pathogens.

4. Meets all drinking water standards
TRANSFORMATIONAL TECHNOLOGY
In contrast to our fellow technologists, we rarely spend time working on futuristic technologies that could take decades to realize.
As we now grapple with the effects of society’s unbridled enthusiasm for pharmaceuticals, nanomaterials, and plastics, solutions that do not include source control or environmental assessment do not seem right to us.

The shortage of speculative research also may be related to the nature of the groups that fund and use our research:

- Cash-strapped utilities, politically constrained regulatory agencies, and the money losing environmental compliance agencies
Better serve society if we place less emphasis on describing environmental research on a continuum from **fundamental** to **applied** and start thinking about our research on a continuum from **incremental** to **disruptive**.

“Perhaps the time has come for us to throw some of our caution to the wind as we confront the grand environmental challenges of the twenty-first century.”