

# Reclaimed Water in Arizona: History of Use and Current Issues

by

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**August 12, 2016**



# *Topics For Today*

**Some reclaimed water history**

**Arizona's current program**

**Into the future: Trends and challenges**

**Of Arizona's 100 largest sewage treatment plants, what percentage distribute treated wastewater for beneficial reuse?**

**10 %**

**20 %**

**30 %**

**40 %**

**50 %**

**60 %**

**70 %**

**80 %**

**90 %**

## Categories of Water (Under the Law)

- Drinking Water
- Surface Water
- Groundwater
- Reclaimed Water
  - Treated wastewater
  - Gray water

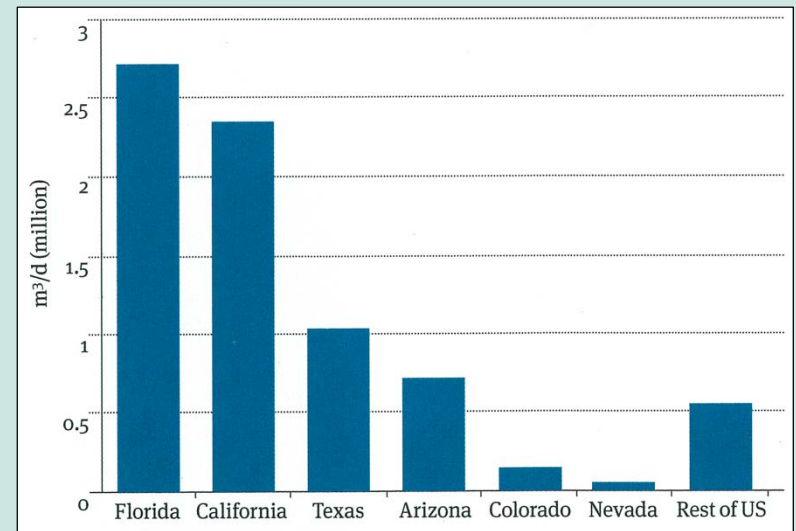


82% of reuse occurs in just four states, Arizona being one



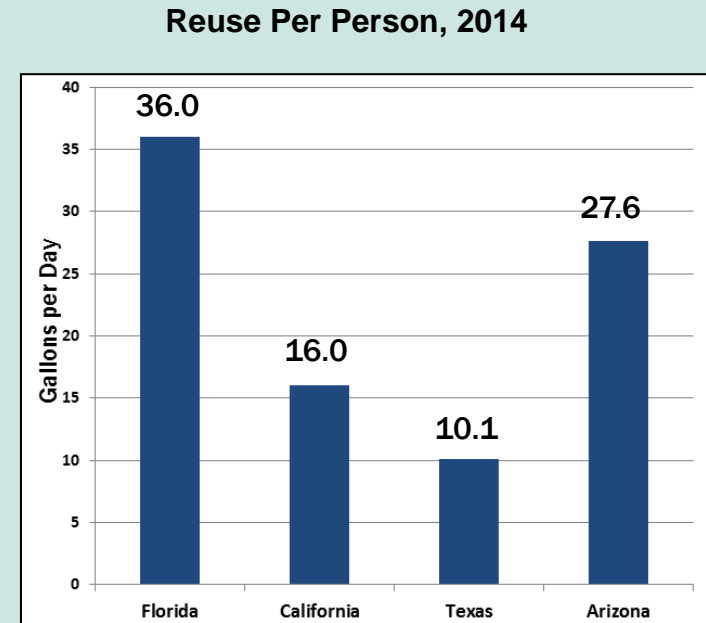
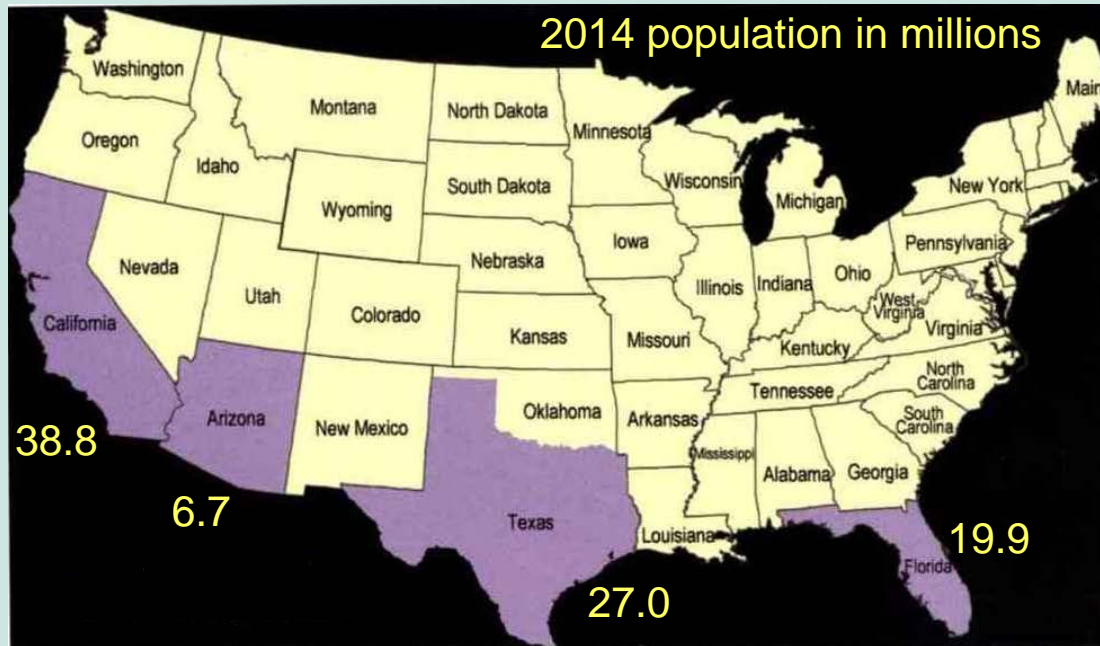
Map: Western Water, July/August 2008

Reused Wastewater Flows, 2014



Source: Bluefield Research

Arizona is 2nd highest nationally in per capita reuse



# Reclaimed Water Use

Water Reuse Capacity (AF/yr)		Reclaimed Water as % of Total Water Supply
Israel	510,000	20%
Singapore	80,783	30%
United States	3,400,000	3%
Florida	955,000	4%
California	807,000	2%
Texas	482,000	3%
Arizona	504,000	7%

**Source:  
Bluefield Research**



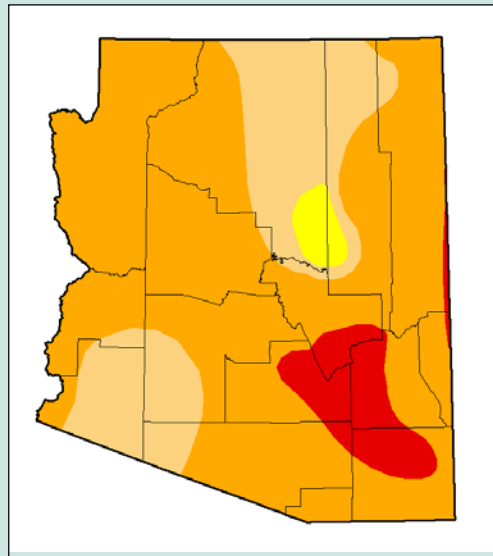
...but #1 at integrating reuse into the water supply portfolio



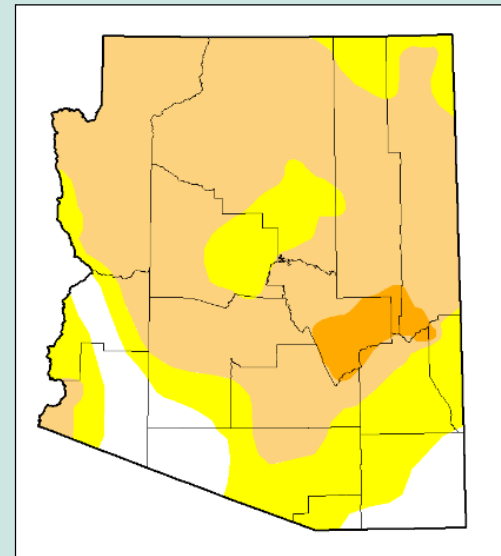
# *Q: Why Arizona?*

## **A<sub>1</sub>: Driven by need**

- We're an arid state!
- We have droughts!



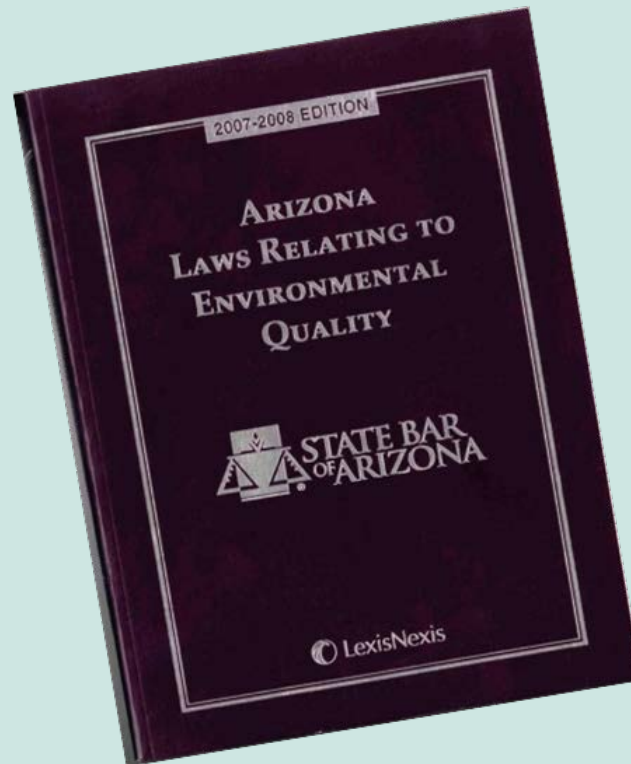
**Drought map – June 2014**



**Drought map – Current**

## *Q: Why Arizona?*

**A<sub>2</sub>: We have a comprehensive legal framework**



# ***Before Wastewater Infrastructure***

- *“Old Bisbee was raucous, crowded, noisy, smoky and vastly overpopulated. Raw sewage ran down the streets.”*
- **Hundreds die from typhoid fever in Bisbee, 1888-90**
- **800 cases in one 10-week period in 1891**
- **Water system (1904) and sewage system (1908) eliminated the problem**



**Raw sewage in Brewery Gulch, Bisbee, 1906**  
**Source: Bisbee Mining & Historical Museum**

## AZ – one of first states to reuse treated wastewater

- Grand Canyon Village – **1926**



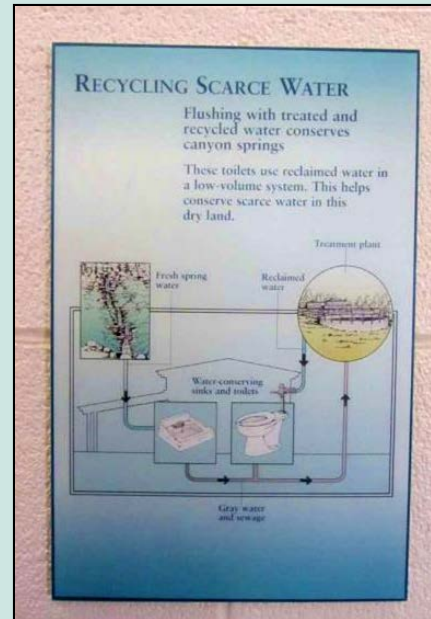
**Grand Canyon – first WWTP in US built specifically to allow reuse (0.13 mgd capacity)**

- Toilet flushing
- Boiler feed for power generation
- Water for steam locomotives



**Grand Canyon Village—  
still water-short,  
still using reclaimed water!**

- Toilet flushing
- Landscape irrigation



**Restroom at Visitor Center,  
Grand Canyon National Park, 2013**

**1932** – irrigated agriculture receives reclaimed water from new Phoenix 23rd Avenue WWTP



- To this day, Phoenix WWTPs supply reclaimed water for irrigated agriculture

# *Sewage Farming: A Trip Back in Time*

## Irrigation with **raw** sewage

- Popular in arid west due to limited water supplies
- Reached peak in CA in 1923
- Over 70 cities had sewage farms for growing food crops

**Sewer farm near Salt Lake City, Utah**



**Source: Utah Historical Society, ca. 1908**



# ***Tucson Sewage Farming: Local Trip Back in Time***

## Irrigation with raw sewage in Tucson

- 1900** – Sewers installed.  
Open ditch from end of sewer to small farm NW of city center.
- 1914** – New 30" main irrigates 120 acre farm 4.5 mi. NW of city center
- 1923** – Farm expands to 750 acres (0.5 x 3 mi.)
- 1928** – Odor complaints and threats of lawsuits prompt construction of first WWTP

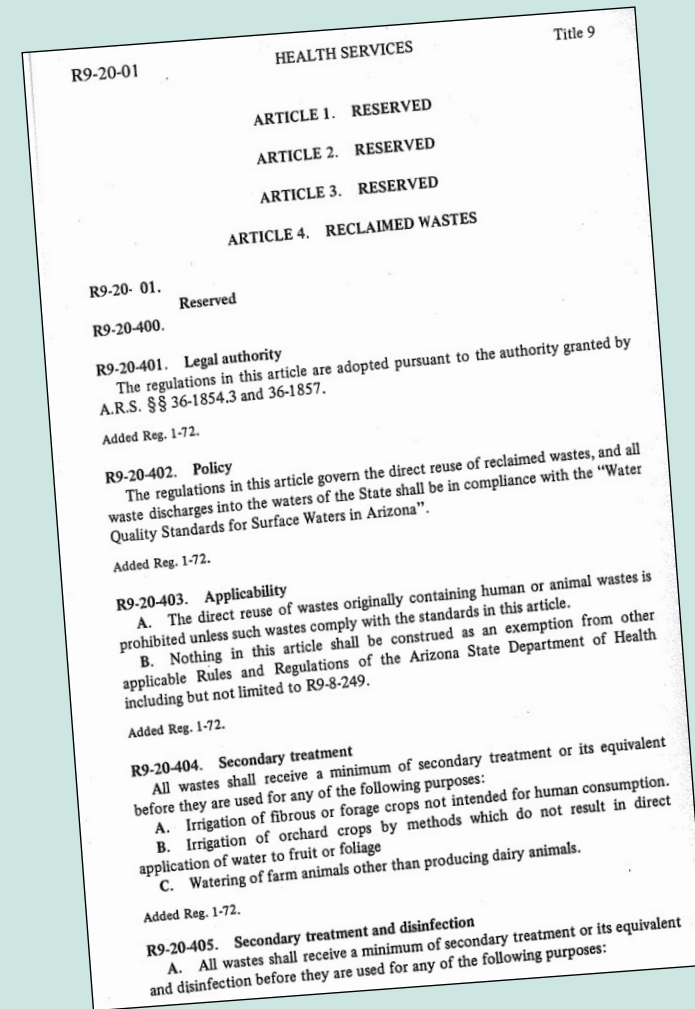


**Plan of Sewerage for Tucson, 1900**  
Source: sewerhistory.org

- **Jan 1972** – 1st reclaimed water rules



**1974—Reclaimed water reuse begins at Fountain Hills**



# *Reclaimed Water for Power Generation*

**1983** – Phx 91<sup>st</sup> Ave WWTP delivers treated wastewater to Palo Verde NGS

- Largest nuclear power plant in US
- Unique in world: 100%-cooled by reclaimed water



**Phoenix 91st Ave WWTP**

# *Reclaimed Water for Power Generation*

## **1983** – Reclaimed water to Palo Verde NGS

- 36 mi. long pipeline
  - 6½' to 9½' diameter
- Delivers 60 mgd
  - 45% of WWTP flow
- 3% of entire US reuse!



**Palo Verde Nuclear Generating Station**

## **2001** – New rules transform program

- Foster reuse while protecting WQ & human health



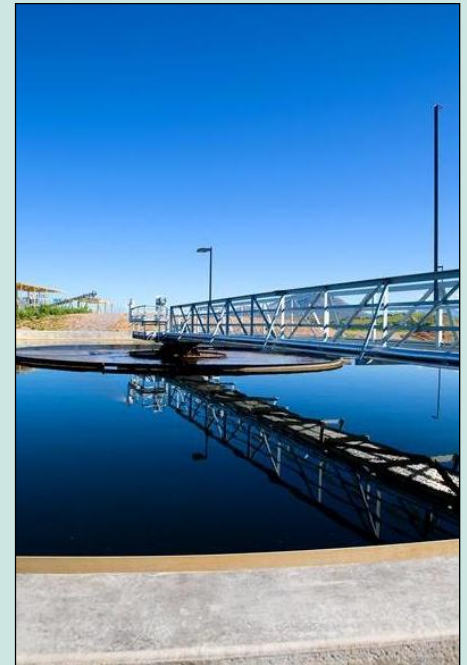
**Reclaimed water pipeline,  
City of Chandler**

## 1. WWTPs must employ Best Available Demonstrated Control Technology (BADCT)

- Pathogen-free effluent
  - No *E. coli*, 4 of 7 daily samples
  - *E. coli* never over 15 cfu/100 ml
- Nitrogen removal, l.t. 10 mg/l
- Odor control



**Nogales  
International  
Wastewater  
Treatment  
Plant,  
upgraded 2009**



## 2. Five reclaimed water quality classes (A+, A, B+, B, C)

- with corresponding allowed end uses



**Class A+ water irrigates  
Safford golf course**

Photo: Mt. Graham  
Golf Course



# *Reclaimed Water Quality*

**Class A+, A → open access uses**

- pathogen-free
- denitrified (A+) } **BADCT**
- **filtration to meet turbidity <2 NTU**



**Turf irrigation with Class A+ water,  
Northern Arizona University, Flagstaff**



# ***Some Class A+ and A Allowable Uses***

- irrigation of food crops
- recreational impoundments
- residential/schoolyard irrigation
- toilet & urinal flushing
- fire protection systems
- snowmaking
- and more



**Reclaimed  
Water  
Fire  
Hydrant**



**Viticulture with reclaimed water, Cottonwood**  
(Yavapai College photo)

# *How Good is A, A+ Reclaimed Water?*

- **Compare with SRP canal water**
  - Delivers water from 6 Salt and Verde River reservoirs
  - Irrigation of yards, parks & school grounds in greater Phoenix area since 1928



**SRP Residential Irrigation, Phoenix**

- **61 Fecal Coliform samples collected by SRP throughout canal system**
  - Highest > 16,000 (cfu/100 ml)
  - Mean = 2360
  - Median = 500
  - **Lowest = 17**
- **Compare to RWQS**
  - Class A+/A = 0



**Photo: Dartmouth Univ.**

# *But... There Are Prohibitions*

- Evaporative cooling, misting
- Full-immersion water activities w/potential for ingestion
  - swimming, windsurfing, water skiing, etc.
- *Direct reuse for human consumption*



## Arizona's 98 largest WWTPs

- Comprise 1/3 of total, yet treat 95% of AZ sewer flows
- **93% distribute at least some reclaimed water for reuse!**

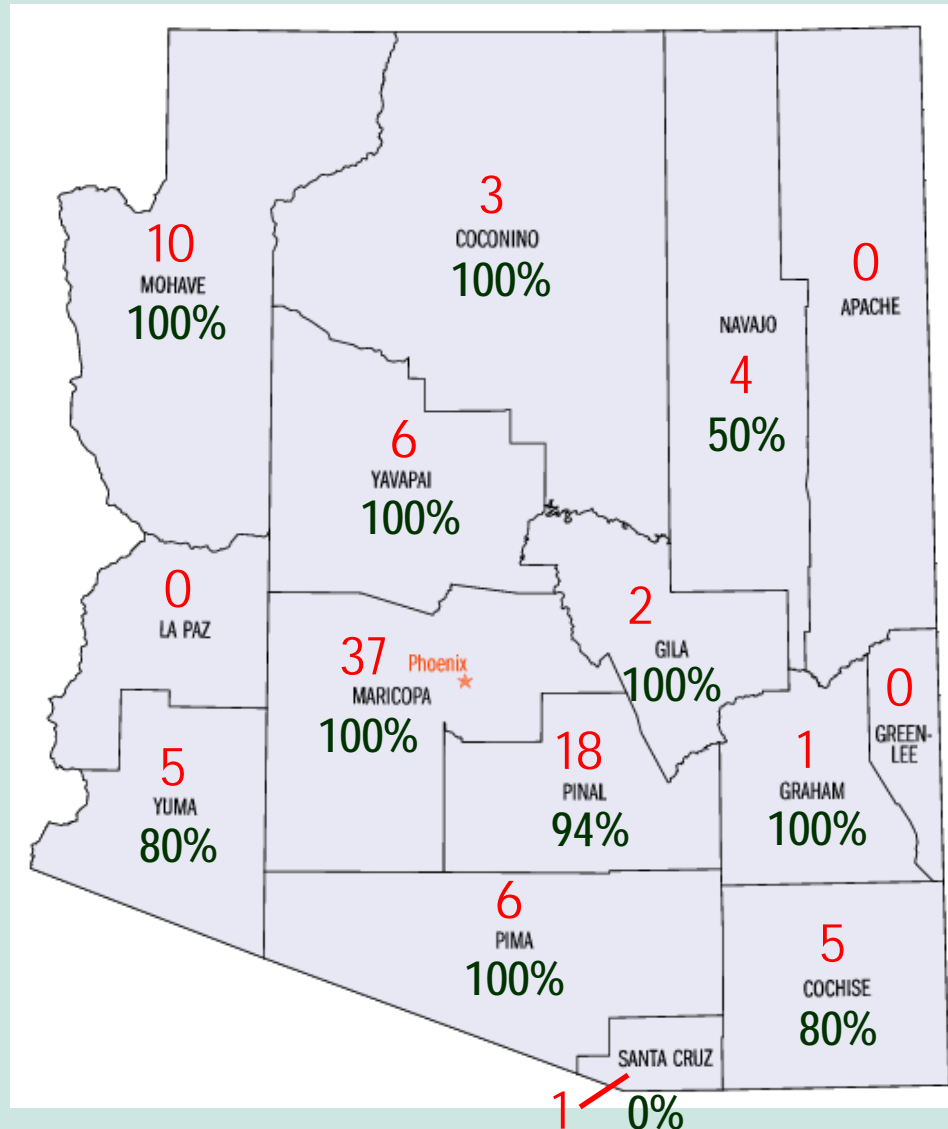


**Landscape impoundment,  
Freestone Park,  
Gilbert, AZ**

# Reuse is Everywhere— Metro & Rural!

WWTPs,  
 design flow  
 $\geq 1$  mgd

**RED,**  
 98 total



Reuse or  
 recharge  
 for credit

**GREEN,**  
 percentage

## Of Arizona's 98 largest WWTPs ( $\geq 1$ mgd)

- 56% distribute Class A+ water



**Mesa Northwest Water  
Reclamation Plant**

# *Reuse is Pervasive*

- More than 82% of treated wastewater generated in the Phoenix metro area is reused
- represents wastewater from 60% of AZ population





# *Reuse in the Greater Phoenix Area*

- **Disposition of treated wastewater**

- Power	22%
- Agriculture	22%
- Recharge	21%
- Environmental (i.e., Tres Rios)	11%
- Landscape, turf irrigation	6%
<b>SUBTOTAL THAT IS REUSED</b>	<b>82%</b>
- Discharged (uncommitted)	18%
<b>TOTAL</b>	<b>100%</b>

# ***Largest Permitted Reclaimed System in AZ***

## **City of Tucson**

- Serves 1000s of residential, M & I, and agricultural users

160 miles of **purple pipe**

18 golf courses

50 parks

65 schools (incl. Univ. of Arizona)

>700 single family homes

**Irrigating athletic field with reclaimed water,  
University of Arizona**



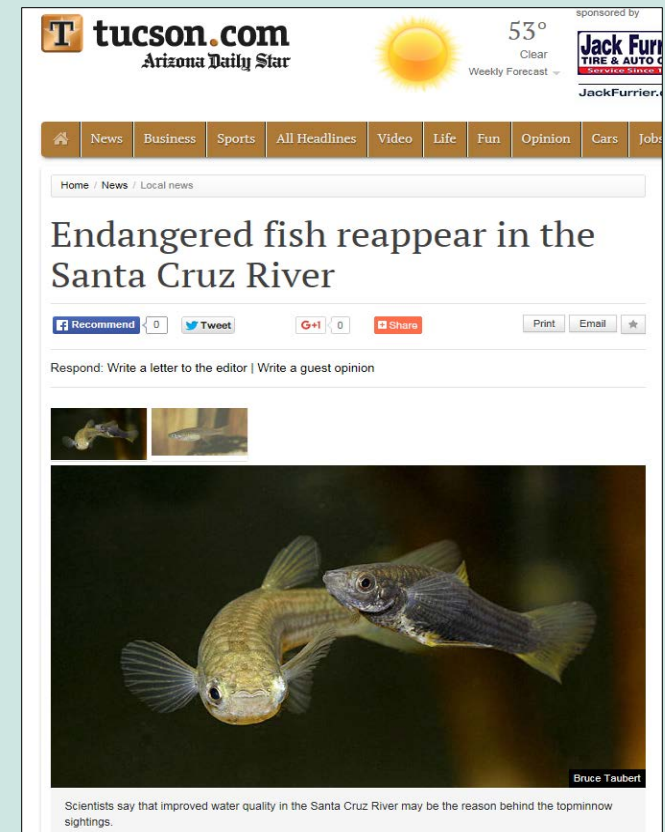
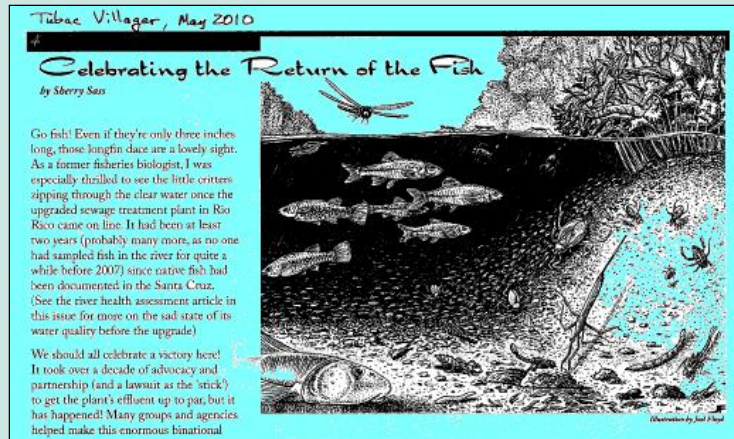
- 56 groundwater recharge facilities recharge reclaimed water under permit
- Permitted recharge is 160,000 af/yr (143 mgd)
  - 16% of permitted design flow of all WWTPs

**Recharging Class A+ reclaimed water,  
Gilbert Riparian Preserve**

Photo: arizonensis.org



- Standards for new/expanding WWTPs has dramatically improved many formerly poor-quality discharges
  - Nutrients
  - Clarity
  - Health risk



**Santa Cruz River below the upgraded Nogales International WWTP comes back to life**

Large majority of WWTPs now produce high-quality treated wastewater suitable for reuse

- Has turned a waste “to be gotten rid of” into a resource with value



**Wheeling reclaimed water around,  
Gilbert Riparian Preserve**



# *Future Trends?*

## Increased off-season utilization



**More ski areas?**

## Alternatives other than golf courses?



**DC Ranch, Scottsdale**

Photo: Cronkite News Service

# ***Biggest Developing Off-season Trend?***

## **More recharge projects to bank groundwater?**

**Existing facilities recharging Class A+ reclaimed water**



### **City of Surprise**

Source: American Academy of  
Environmental Engineers  
and Scientists



### **Town of Prescott Valley**

### **Payson Green Valley Lake**



## Transition to higher-valued end uses

More industrial reuse?

**Existing  
high-value  
end uses**



**SCA Tissues, Flagstaff**  
Recycled paper production



**Intel Ocotillo Campus, Chandler**  
Semiconductor fabrication



# Higher Value End Use: Craft Beers, Too?



Photo: Milwaukee Journal Sentinel

“a little bit of me,  
a little bit of you”

**SALON** NEWS POLITICS ENTERTAINMENT LIFE TECH BUSINESS SUS

WEDNESDAY, JAN 28, 2015 03:17 PM MST

## Craft beer made from recycled sewage water is coming soon to Portland

A toast, to water conservation!

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**TOPICS:** WATER WASTE, PORTLAND, SEWAGE, CRAFT BEER, FOOD, INNOVATION NEWS, SUSTAINABILITY NEWS, NEWS

A close-up photograph of a glass of beer being poured. The beer is golden with a thick white head of foam. The background is dark and out of focus.

(Credit: Igor Kilmov/Shutterstock)

## More multi-purpose & community enrichment projects



**Kino Environmental  
Restoration Project  
(combined reclaimed/  
stormwater)**

Credit: Pima County



**Town of Payson  
Green Valley Lake**



**Anthem Community Park**  
Credit: MCM Group



**Birdwatching blind,  
Veterans Oasis Park, Chandler**  
Credit: Buck-Fever

# *Unintended Consequences?*

Is reclaimed water becoming so valuable that riparian areas dependent on it are becoming threatened?



**Santa Cruz River below  
Nogales International WWTP**

Photo: Channing Turner, Cronkite News



# ***ADEQ is Revising its Rules: Why?***

- 1. Keep up with the rapidly moving reclaimed/reuse field**
- 2. Sustainable water supplies are becoming increasingly important**

## **Three listening session workshops held**

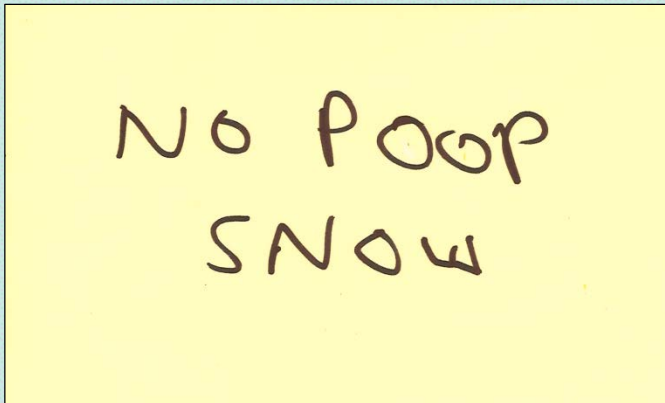
**Feb 12 Tucson**

**Mar 10 Phoenix**

**May 5 Flagstaff**

# *Listening Session Workshops*

- 40 - 70 people attended each workshop
- More than 300 comments received



- Compiled into Issues Matrix

<http://www.azdeq.gov/reclaimed-water-rulemaking>

# ***Selected Issues from Stakeholders***

**Allow easier integrated use of reclaimed water with other waters (stormwater, canal water, etc.)**

**Review reclaimed water quality standards**

**Address emerging contaminants**

**Allow new end uses**

**- including riparian restoration/enhancement**

**Remove prohibition for reuse of reclaimed water for human consumption**



**Kino Environmental Restoration Project (combined reclaimed/stormwater)**

Credit: Pima County

# ***Gray Water Issues From Stakeholders***

**Continue allowing household gray water use without having to get a permit or pay a fee**

**Develop streamlined permits for large-scale, non-residential use of gray water**



**Large-scale gray water reuse,  
Barrett Honors College, ASU**



- **Establish expert workgroups**
  - Technology
  - Reclaimed water quality standards
- **Adopt first rule package by end of 2016?**
- **Adopt second rule package by end of 2017?**

***To be on listserv for rule revision:***

***Send e-mail to: [reuserulemaking@azdeq.gov](mailto:reuserulemaking@azdeq.gov)***

***Or e-mail me at: [cgg@azdeq.gov](mailto:cgg@azdeq.gov)***

***Rule revision info & Issue Matrix:***

***<http://www.azdeq.gov/reclaimed-water-rulemaking>***



**Town of Payson  
Green Valley Lake**