# Opportunities and Challenges in Regulating Safe Urban and Rural Onsite Water Recycling

by
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Southwest Onsite Wastewater Conference
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Arizona Department of Environmental Quality

# Topics for Today

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## How Arizona regulates wastewater treatment facilities

- community WWTPs
- on-site systems

## How Arizona regulates reclaimed/recycled waters

## Recent revisions to reclaimed/recycled water rules

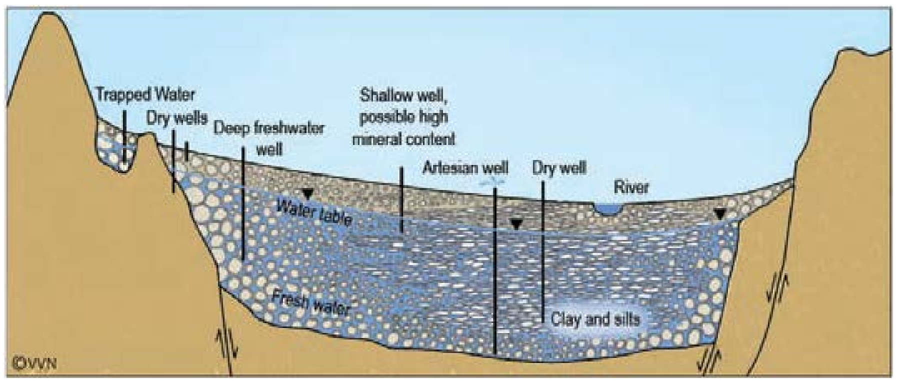
## Challenges and opportunities

- "on-site" water recycling
- "onsite" water recycling

# Aquifer Protection Permit Program

- Unique AZ permit that regulates discharges to protect groundwater for "drinking water protected use"

Palo Verde Nuclear Generating Station




ASARCO Ray Mine

- ADEQ issues APPs to mines, industrial facilities, WWTPs, etc., to control discharges to groundwater

# Aquifer Protection Permits

- **Individual APPs**
  - Mines
  - Power plants & other industrial facilities
  - Sewage treatment plants (306)


Mines southwest of Tucson

APS Cholla Power Plant, Joseph City

Nogales International Wastewater Treatment Plant

# The Two Pillars of APP Protection

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1. **Must not exceed any Aquifer Water Quality Standard (i.e., MCL) at a point of compliance (POC) in the aquifer**

- POC set in aquifer at limit where pollutants are placed (e.g., dike, impoundment, etc.)
- No further degradation if AWQS already exceeded



Palo Verde Nuclear Generating Station

# The Two Pillars of APP Protection

2. Facility also must employ Best Available Demonstrated Control Technology (BADCT)
   - Example: BADCT for new or expanding WWTPs
     - EPA Secondary Standards
     - Pathogen-free effluent
     - Nitrogen removal
     - Odor control

Expansion and upgrade in 2009 to Nogales International Wastewater Treatment Plant

# Individual APP Requirements

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- BADCT
- Comprehensive monitoring requirements
  - Includes real-time turbidity monitoring for WWTPs
- Record keeping and reporting requirements
- Certified operator (for WWTPs)

# Typical WWTP Monitoring

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## Bullhead City WWTP (monitoring tables from p. 19-23 of 31-page permit)

**TABLE IA-II**
**ROUTINE DISCHARGE MONITORING**

| Sampling Point Number | Sampling Point Identification | | Latitude | | Longitude |
|---|---|---|---|---|---|
| 3 | Downstream of the chlorine contact basin | | 35° 07' 30.8" N | | 114° 32' 59.9" W |
| **Parameter** | **AL** | **DL** | **Units** | **Sampling Frequency** | **Reporting Frequency** |
| Fecal Coliform: Single sample maximum | No Limit | 23.0 | CFU or MPN[13] | Daily | Quarterly |
| Fecal Coliform: four (4) of seven (7) samples in a week[14] | Not established | Non-detect[15] | CFU or MPN | Daily | Quarterly |
| Total Nitrogen[16]: Five-sample rolling geometric mean | 8.0 | 10.0 | mg/l | Monthly[17] | Quarterly |

**TABLE IB**
**RECLAIMED WATER MONITORING - CLASS A+[24]**

| Sampling Point Number | Sampling Point Identification | | Latitude | Longitude |
|---|---|---|---|---|
| 3 | Downstream of the chlorine contact basin | | 35° 07' 30.8" N | 114° 32' 59.9" W |
| **Parameter** | **DL** | **Units** | **Sampling Frequency** | **Reporting Frequency** |
| Fecal Coliform: Single-sample maximum | 23.0 | CFU or MPN[26] | Daily[27] | Quarterly |
| Fecal Coliform: Four (4) of last seven (7) samples | Non-detect[28] | CFU or MPN | Daily | Quarterly |
| Total Nitrogen[29]: Five-sample rolling geometric mean | 10.0 | mg/l[30] | Monthly | Quarterly |
| Turbidity[31]: Single reading | 5.0 | NTU[32] | Everyday[33] | Quarterly |
| Turbidity: 24-hour average | 2.0 | NTU | Everyday | Quarterly |
| Enteric Virus[34]: Four (4) of last seven (7) samples | Non-detect | PFU[35] | Monthly / Suspended[36] | Quarterly |

**TABLE IA-II**
**ROUTINE DISCHARGE MONITORING (continued)**

| Parameter | AL | DL | Units | Sampling Frequency | Reporting Frequency |
|---|---|---|---|---|---|
| **Metals (total):** | | | | | |
| Antimony | 0.0048 | 0.006 | mg/l | Quarterly | Quarterly |
| Arsenic | 0.04 | 0.05 | mg/l | Quarterly | Quarterly |
| Barium | 1.60 | 2.00 | mg/l | Quarterly | Quarterly |
| Beryllium | 0.0032 | 0.004 | mg/l | Quarterly | Quarterly |
| Cadmium | 0.004 | 0.005 | mg/l | Quarterly | Quarterly |
| Chromium | 0.08 | 0.1 | mg/l | Quarterly | Quarterly |
| Cyanide (as free cyanide) | 0.16 | 0.2 | mg/l | Quarterly | Quarterly |
| Fluoride | 3.2 | 4.0 | mg/l | Quarterly | Quarterly |
| Lead | 0.04 | 0.05 | mg/l | Quarterly | Quarterly |
| Mercury | 0.0016 | 0.002 | mg/l | Quarterly | Quarterly |
| Nickel | 0.08 | 0.1 | mg/l | Quarterly | Quarterly |
| Selenium | 0.04 | 0.05 | mg/l | Quarterly | Quarterly |
| Thallium | 0.0016 | 0.002 | mg/l | Quarterly | Quarterly |

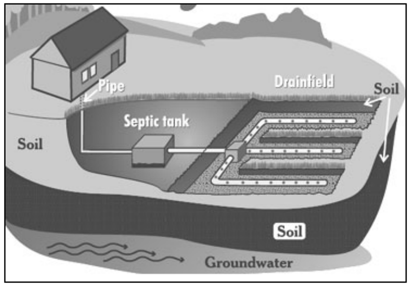
**TABLE IA-II**
**ROUTINE DISCHARGE MONITORING (continued)**

| Parameter | AL | DL | Units | Sampling Frequency | Reporting Frequency |
|---|---|---|---|---|---|
| **Volatile Organic Compounds (VOCs):** | | | | | |
| Benzene | 0.004 | 0.005 | mg/l | Semi-Annually | Semi-Annually |
| Carbon tetrachloride | 0.004 | 0.005 | mg/l | Semi-Annually | Semi-Annually |
| o-Dichlorobenzene | 0.48 | 0.6 | mg/l | Semi-Annually | Semi-Annually |
| para-Dichlorobenzene | 0.06 | 0.075 | mg/l | Semi-Annually | Semi-Annually |
| 1,2-Dichloroethane | 0.004 | 0.005 | mg/l | Semi-Annually | Semi-Annually |
| 1,1-Dichloroethylene | 0.0056 | 0.007 | mg/l | Semi-Annually | Semi-Annually |
| cis-1,2-Dichloroethylene | 0.056 | 0.07 | mg/l | Semi-Annually | Semi-Annually |
| trans-1,2-Dichloroethylene | 0.08 | 0.1 | mg/l | Semi-Annually | Semi-Annually |
| Dichloromethane | 0.004 | 0.005 | mg/l | Semi-Annually | Semi-Annually |
| 1,2-Dichloropropane | 0.004 | 0.005 | mg/l | Semi-Annually | Semi-Annually |
| Ethylbenzene | 0.56 | 0.7 | mg/l | Semi-Annually | Semi-Annually |
| Monochlorobenzene | 0.08 | 0.1 | mg/l | Semi-Annually | Semi-Annually |
| Styrene | 0.08 | 0.1 | mg/l | Semi-Annually | Semi-Annually |
| Tetrachloroethylene | 0.004 | 0.005 | mg/l | Semi-Annually | Semi-Annually |
| Toluene | 0.8 | 1.0 | mg/l | Semi-Annually | Semi-Annually |
| 1,1,1-Trichloroethane | 0.16 | 0.2 | mg/l | Semi-Annually | Semi-Annually |
| 1,2,4 - Trichlorobenzene | 0.056 | 0.07 | mg/l | Semi-Annually | Semi-Annually |
| 1,1,2 - Trichloroethane | 0.004 | 0.005 | mg/l | Semi-Annually | Semi-Annually |
| Trichloroethylene | 0.004 | 0.005 | mg/l | Semi-Annually | Semi-Annually |
| Vinyl Chloride | 0.0016 | 0.002 | mg/l | Semi-Annually | Semi-Annually |
| Xylenes (Total) | 8.0 | 10.0 | mg/l | Semi-Annually | Semi-Annually |

| Parameter | AL | DL | Units | Sampling Frequency | Reporting Frequency |
|---|---|---|---|---|---|
| **Indicator Parameters / Major Cations and Anions:** | | | | | |
| pH (field) | Monitor[18] | Monitor | S.U. | Quarterly | Quarterly |
| Iron | Monitor | Monitor | mg/l | Quarterly | Quarterly |
| Manganese | Monitor | Monitor | mg/l | Quarterly | Quarterly |
| Total Organic Carbon | Monitor | Monitor | mg/l | Quarterly | Quarterly |
| Total Dissolved Solids | Monitor | Monitor | mg/l | Quarterly | Quarterly |
| Sodium | Monitor | Monitor | mg/l | Quarterly | Quarterly |
| Potassium | Monitor | Monitor | mg/l | Quarterly | Quarterly |
| Calcium | Monitor | Monitor | mg/l | Quarterly | Quarterly |
| Magnesium | Monitor | Monitor | mg/l | Quarterly | Quarterly |
| Chloride | Monitor | Monitor | mg/l | Quarterly | Quarterly |
| Sulfate | Monitor | Monitor | mg/l | Quarterly | Quarterly |
| Alkalinity | Monitor | Monitor | mg/l | Quarterly | Quarterly |
| Specific Conductivity (field) | Monitor | Monitor | µmhos/cm | Quarterly | Quarterly |

# General Aquifer Protection Permits

- Septic tanks & alternative on-site WW treatment facilities
  - Serve 15 - 17% of AZ population
  - About 6000 new installations per year
  - Delegated to county health & environmental departments




- Sewage collection systems (sewer lines)


- Many other miscellaneous discharges

# General APP Characteristics

- Most design & operational elements are prescribed in rule
- Less flexibility than Individual APPs, but simpler and less costly
- Two part permit for on-sites & sewage collection systems
  - Construction Authorization (CA)
  - Discharge Authorization (DA)

# General APP Characteristics

- Generally no ongoing monitoring and reporting
  - Design/technology requirements are intended to be robust enough to eliminate need for ongoing monitoring
  - If monitoring is prescribed, usual requirement is to maintain records & only report out-of-limit results
- Permit covers design, construction & **operation** (i.e., the discharge)
  - in other words, it's continuously enforceable
- Generally no certified operator or service contract requirement

# On-site System General APPs:

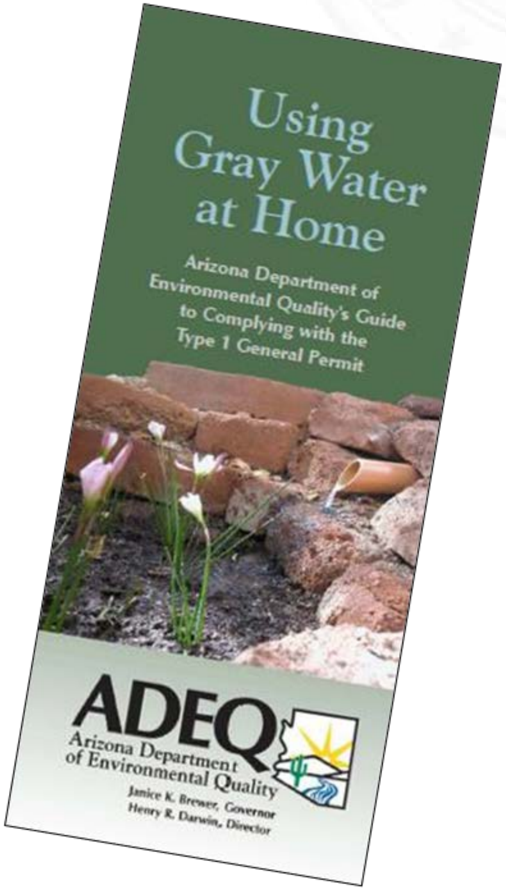
## Two Flow Categories for On-site Systems

- Design flow less than 3000 gpd
  - nitrogen control in new subdivisions is through lot size limits
- Design flow 3000 to less than 24,000 gpd
  - nitrogen loading limits
  - design docs sealed by a PE
  - construction completion certified by a PE
  - operation by a service provider or certified operator
  - Annual Report submitted by a service provider or certified operator
  - aerobic systems excluded, which need an Individual APP

# Arizona is a Leader in Reuse

## Reclaimed Water


## Gray Water



# Reclaimed Water Key Dates

1972 – **First reclaimed water rules, ADHS**

2001 – **Comprehensive rules transform program**

Viticulture with reclaimed water, Cottonwood (Yavapai College photo)

Reclaimed water pipeline, City of Chandler

# Grand Canyon Village

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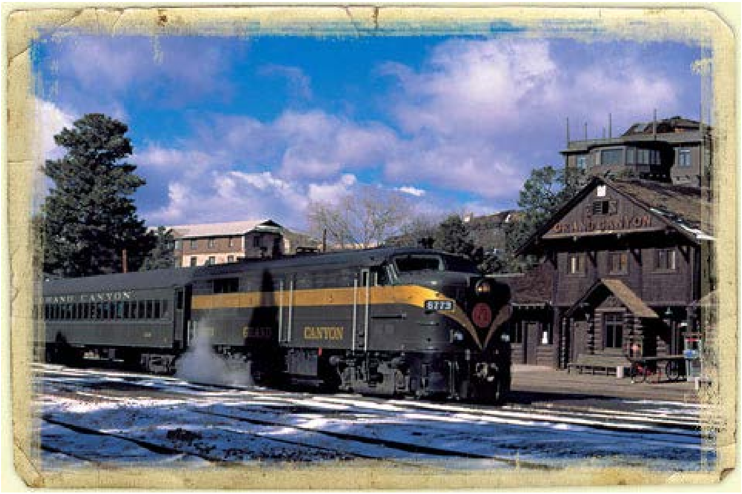
## 1926 – First WWTP in US built specifically to allow reuse (0.13 mgd capacity)

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

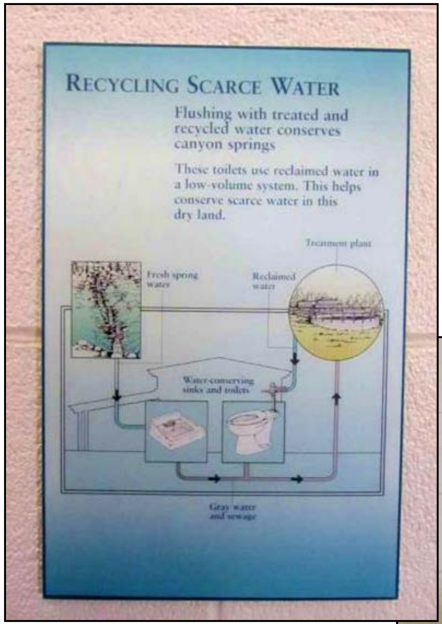


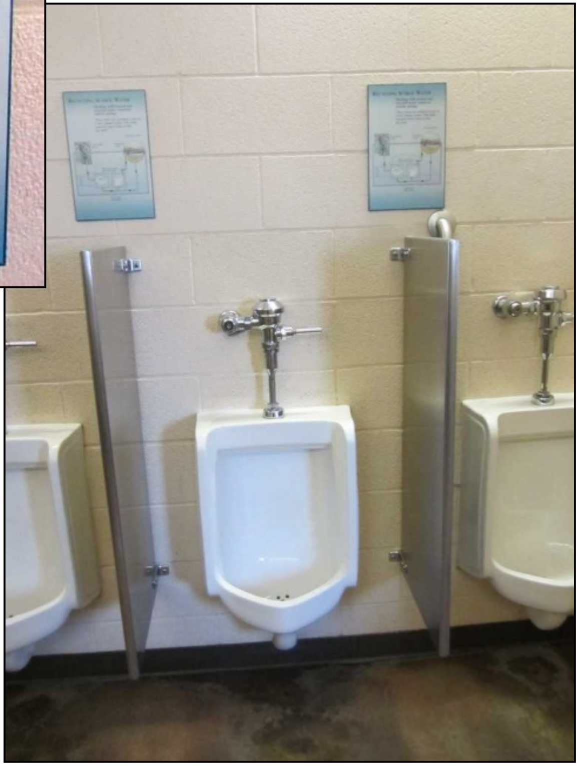
# Grand Canyon Village

Still water-short today,

still using reclaimed water!

- Toilet flushing
- Landscape irrigation



Restroom at Visitor Center,
Grand Canyon National Park, 2013

# 2001 Reclaimed Water Rules

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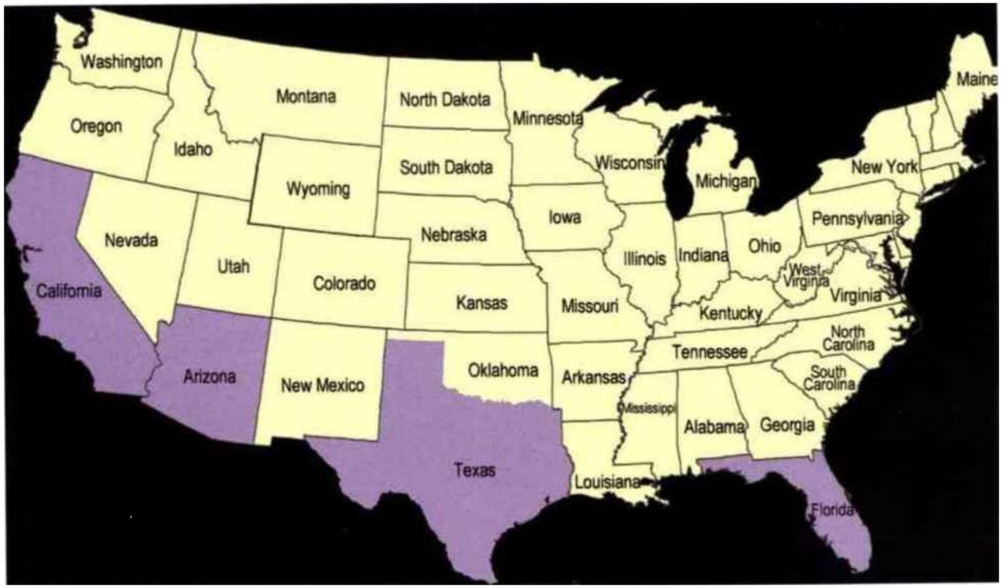
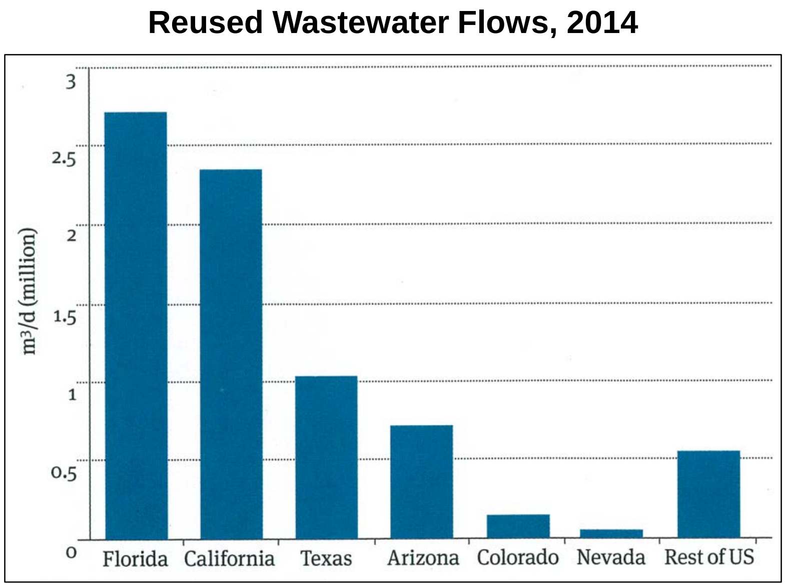
- Reclaimed rules govern reuse (vs. APP, which controls discharges)
- Stringent treatment standards for new/expanded WWTPs under APP
- Allows simple end use permits for reuse
- RWQS for five classes of reclaimed water (A+, A, B+, B, C)
- List of end uses allowed for the five classes


# Rules Helped Spur Reuse, National Prominence

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



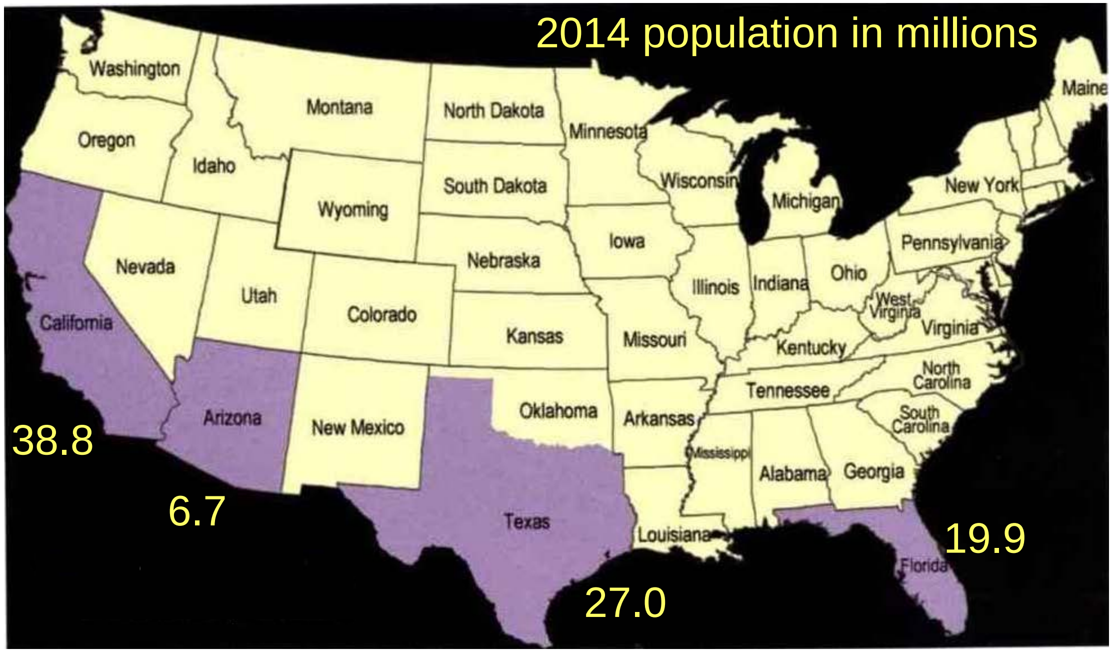

Map: Western Water, July/August 2008

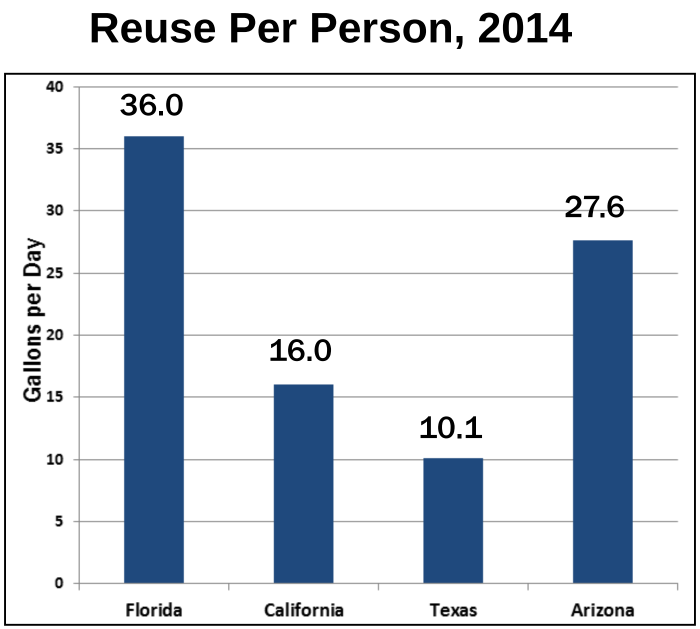



Source: Bluefield Research

# Rules Helped Spur Reuse, National Prominence

## Arizona is 2nd highest nationally in per capita reuse



# Rules Helped Spur Reuse, National Prominence

| | 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

# BADCT Review

## Stringent treatment standards for new & expanding WWTPs

- Pathogen-free effluent
  - No *E. coli*, 4 of 7 daily samples
  - Never over 15 cfu/100 ml
- Nitrogen removal, ≤10 mg/l
- Turbidity, ≤2 NTU (5 max)
- Odor control


Photo: Dartmouth Univ.

**Stringent treatment standards ⟶ clean water for reuse**

# Some Class A+/A Allowed Uses

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


Arizona Snowbowl

Reclaimed Water
Fire Hydrant

Landscape impoundment,
Freestone Park,
Gilbert, AZ

# *In Arizona, Reuse is Ubiquitous!*

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## ADEQ's 98 largest permitted WWTPs (> 1 mgd)

- 93% distribute reclaimed water for reuse/recharge
- 56% distribute Class A+ water

**100% reuse**

**EPCOR Wishing Well WWTP,**
**Ft Mohave, 1 mgd,**
Valentine Engineering photo

**100% reuse and recharge**

**City of Scottsdale**
**Water Campus, 20 mgd**
Credit: Aerotech Mapping

## 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

# *But … no reuse for on-site systems*

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- General APP does not adequately address:

  - ongoing monitoring

  - reporting

  - operator & operation reliability

**"Our codes struggle with care."**

- Dave Gustafson (Jan. 31, 2018)

# *Gray Water: Is Spelling It Our Biggest Impediment?*

**Gray water**

**Graywater**

**Grey water**

**Greywater**

*In Arizona law, it's "gray water."*

# What is Gray Water?

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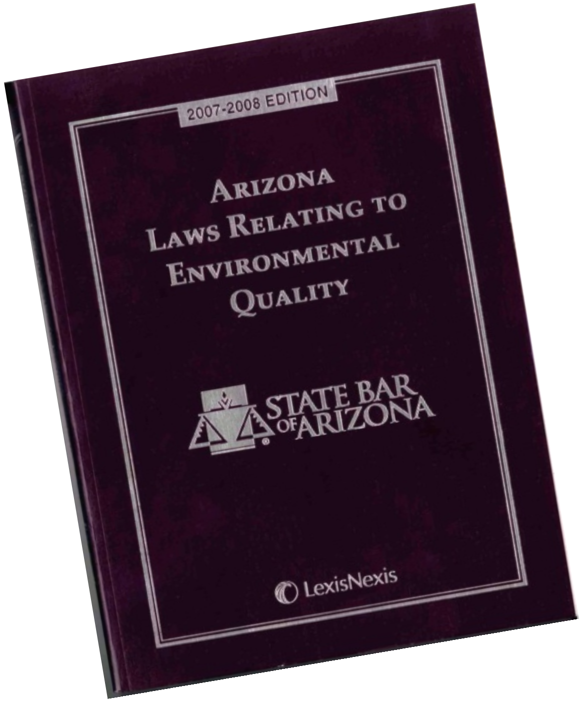
- Arizona law defines gray water as wastewater that:

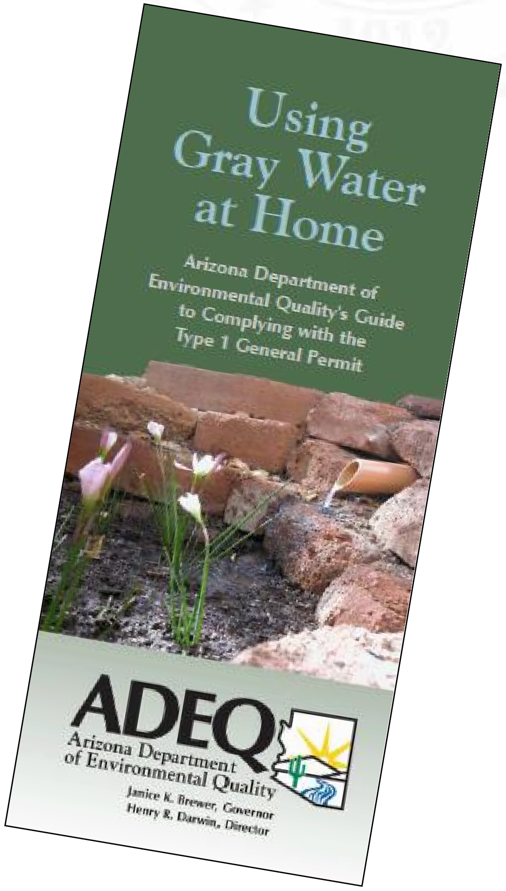
  - is collected separately from a sewage flow
  - originates from a
    - clothes washer
    - bathroom tub, shower or sink
  - does not include wastewater from
    - kitchen sink
    - dishwasher
    - toilet




**Arizona Revised Statutes §49-201(18)**

# Gray Water Rules
# Also Greatly Changed In 2001

- Merged into the reclaimed water rules
- Removed requirement for “hard permitting” of home gray water use
- New focus on education—simple BMPs for home use



# Gray Water After 2001

- Home gray water use is permitted without registration or application to ADEQ as long as:

  - BMPs in rules are followed

  - gray water flow is less than 400 gal/day

  - use is for single-family homes

  - use is for irrigation or composting

Photo by Brad Lancaster

ADEQ Arizona Department of Environmental Quality

# *Simple BMPs for Home Use— Opted for the Education Approach!*

- Avoid human contact
- No hazardous chemicals
- Minimize standing water
- No surface application for food plants (citrus & nut trees OK)
- Cover storage tanks for insect/vector control
- 5 foot separation to groundwater

Photo by Brad Lancaster

# Larger-Scale Gray Water Use:

## An Untapped Opportunity

### Arizona State University, Barrett Honors College, Tempe, AZ

- *Permit issued:* 2009
- *Design flow:* 7000 gal/day
- *Sources:* Showers, sinks from classrooms & dormitories for 200 students
- Lift station, storage tanks, recirculating sand filter, mechanical filter, flow meter


- Irrigates 0.60 acre of turf, desert plants

# LEED Certification is an Incentive

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- Green building certification is driving some large-scale gray water projects

- Credit points given for gray water use

- For higher gold & platinum certifications, gray water reuse is almost a necessity to gain enough points


# *Why the current rule revision?*

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- Keep up with rapid reclaimed/reuse advancements
- Ever more need for sustainable water supplies
- Need to review 2001 reclaimed water quality standards
- Need to address potable reuse
- Improve the regulatory framework for reuse


**Advanced treatment of reclaimed water, Scottsdale Water Campus**
City of Scottsdale photo

# What's new in the new rule?

- It's already in place…effective 1/1/2018!
- Defines a new term: recycled water

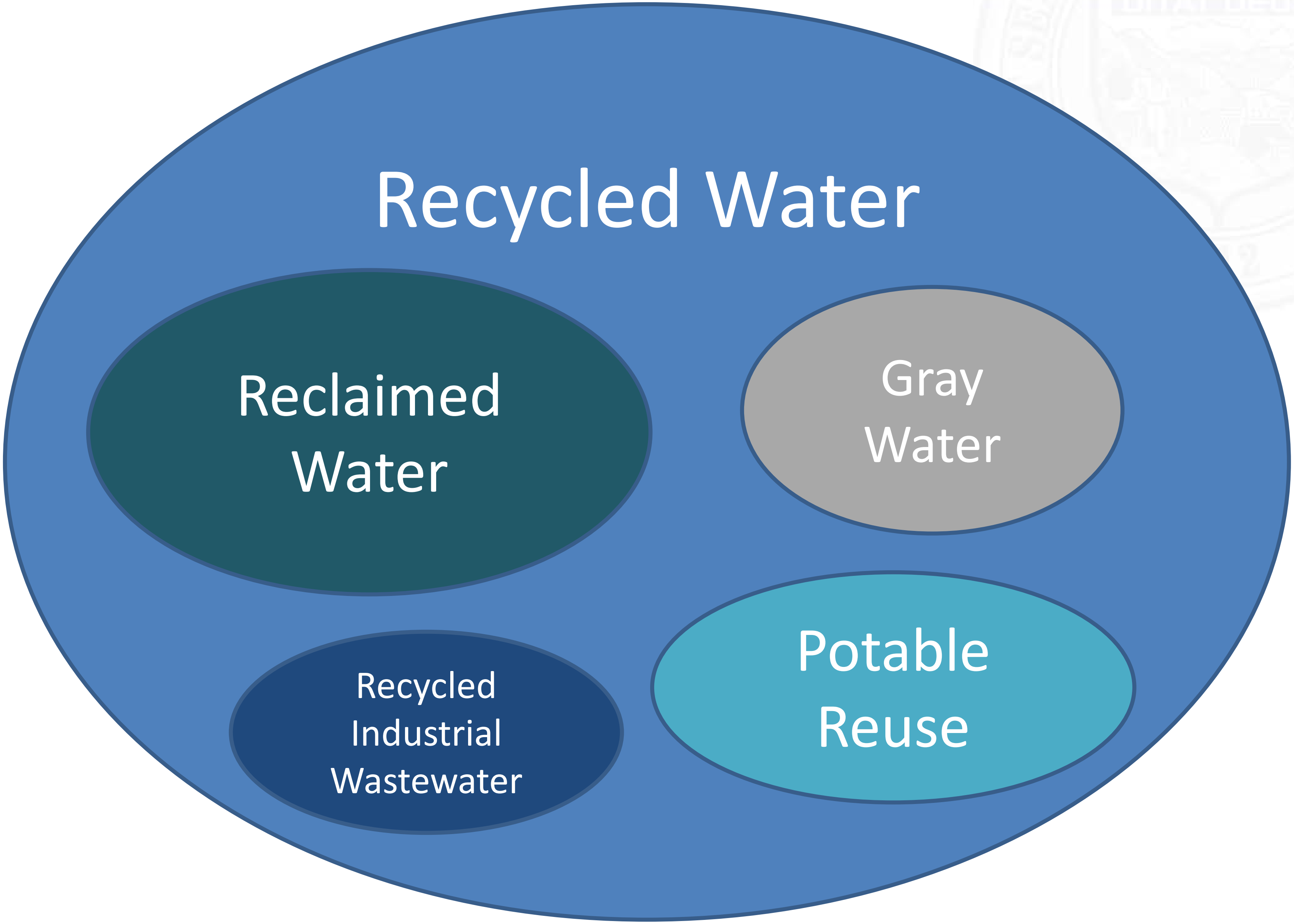
# "Recycled Water" means...

"a processed water that originated as a waste or discarded water, including reclaimed water and gray water, for which the Department has designated water quality specifications to allow the water to be used as a supply."

# What's new in the new rule?

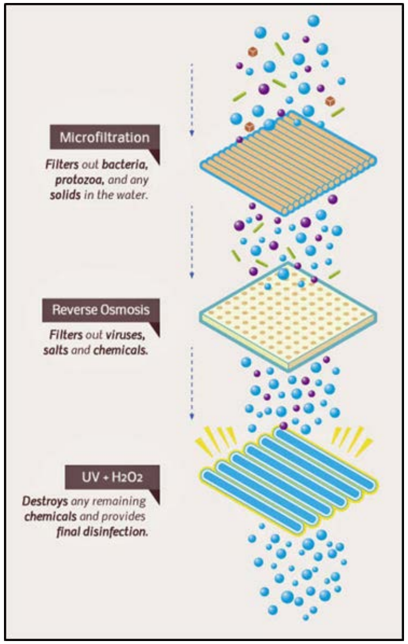
- Establishes a new regulatory framework

# New Rule Framework as of 1/1/2018



# The Recycled Water Umbrella

| Article 7 | Use of **Recycled Water** |
|---|---|
| Part A | General Provisions |
| Part B | Reclaimed Water |
| Part C | Recycled Industrial Wastewater |
| Part D | Gray Water |
| Part E | Purified Water for Potable Use |




Representative Advanced Treatment of Reclaimed Water For Potable Use

# What's new in the new rule?

- Fixes and improvements to the recycled water permitting process
  - Annual reporting changed to calendar year
  - Easy to make informational changes
  - Clearer permit revocation language
  - Signage requirement changes for reclaimed water

PERMITS 2.0

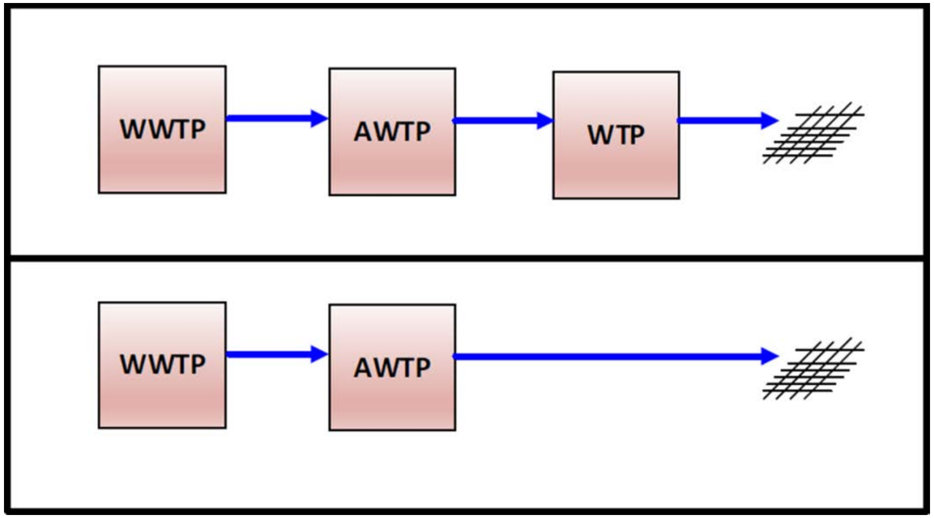
# What's new in the new rule?

- New permit and interim criteria for direct potable reuse (DPR)

# ARWTF Definition

## “Advanced reclaimed water treatment facility” means:

- A facility that treats and purifies Class A+ or Class B+ reclaimed water to produce potable water suitable for distribution for human consumption.
- Potable water produced by an advanced reclaimed water treatment facility is not reclaimed water.




Source: Larry Schimmoller, CH2M

# *Interim Criteria for DPR Permit*

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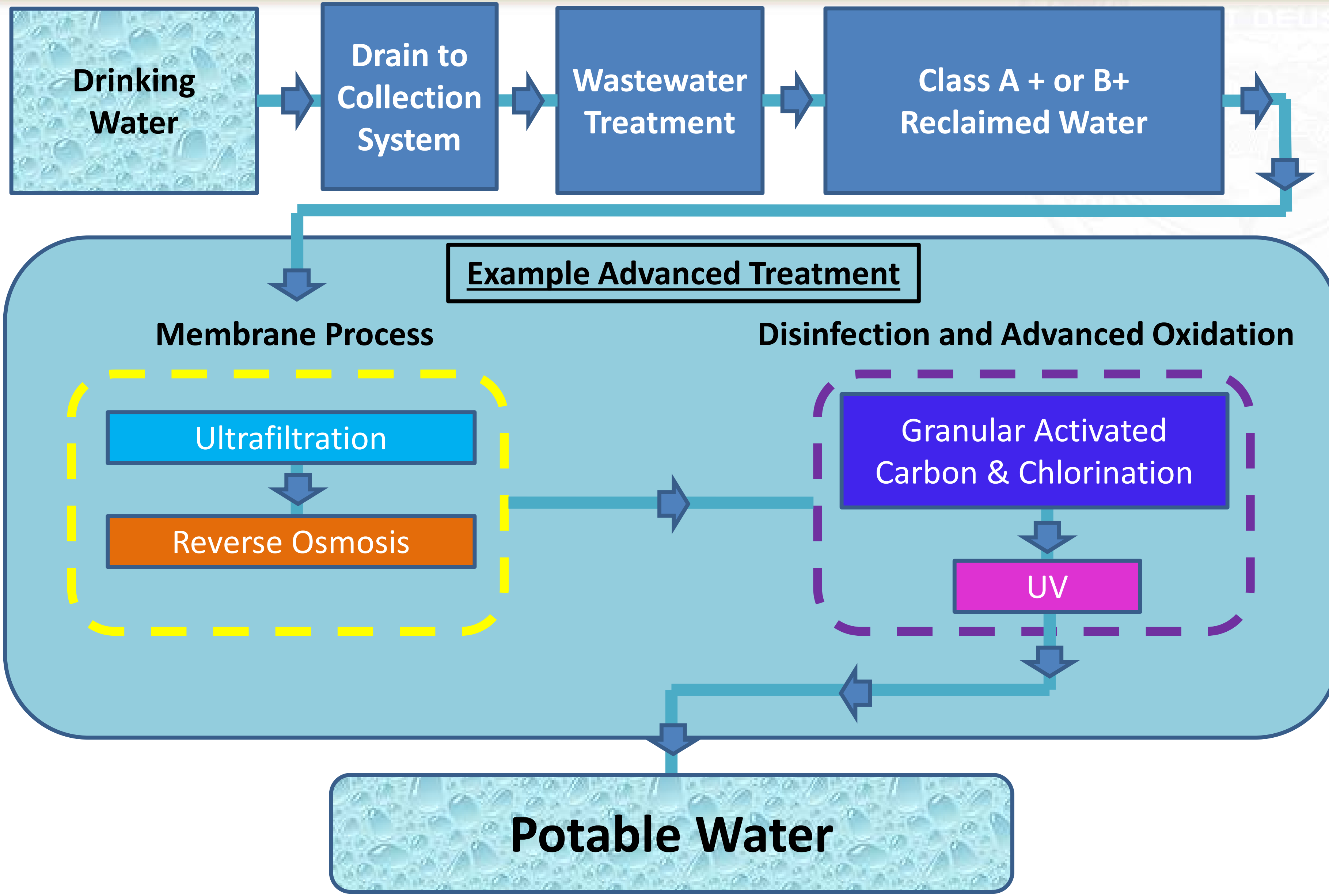
- Source water characterization
- Pilot treatment system
- Microbial control technology
- Microbial logarithmic reduction targets
- Chemical control technology
- Monitoring plan
- Start-up plan
- Operation and maintenance plan
- Operator Training
- Technical, financial, and management capability

# ARWTF Example



# What's new in the new rule?

- Some tweaks to BMPs for household gray water
  - More emphasis on minimizing standing water
    - examples are now listed
  - Storage of gray water is deemphasized
    - holding time should be minimized to prevent anaerobic conditions and odors
  - Blockage, backage, and overload provision changed
    - now no requirement for connection to sewer or septic tank
    - now states that distribution should cease until condition is corrected

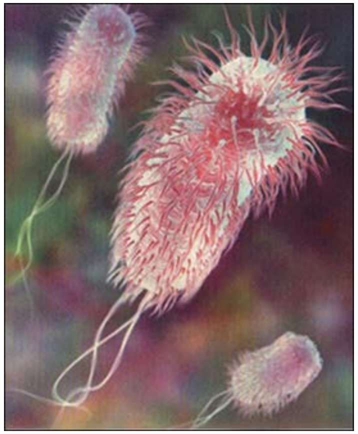
# What's new in the new rule?

- More usable permit for larger-volume gray water use (up to 3000 gpd)
  - may include drinking fountain water
  - removed impediment requiring use of a septic tank-like disposal field
  - now simply requires subsurface distribution
    - must be no standing water on the surface

**Subsurface irrigation with gray water and harvested rainwater,
Reid Park Zoo Training Center, Tucson**

# What's NOT in the new rule?

- Final criteria for DPR
- Changes to the Reclaimed Water Quality Standards rules
  - Reclaimed water quality classes
  - Actual water quality standards
  - Allowed end uses



***E. coli* bacteria**
(Univ. of Vermont image)

# Expert Work Groups

- Formed in 4/2017 to provide recommendations to ADEQ for Phase 2 rulemaking
- Completed work earlier this week
  - *Reclaimed WQ standards*, Dr. Channah Rock, Chair
    - review standards based on current science
  - *Infrastructure/technology*, Tim Thomure, Chair
    - detailed criteria for potable reuse

# What's also NOT in the new rule?

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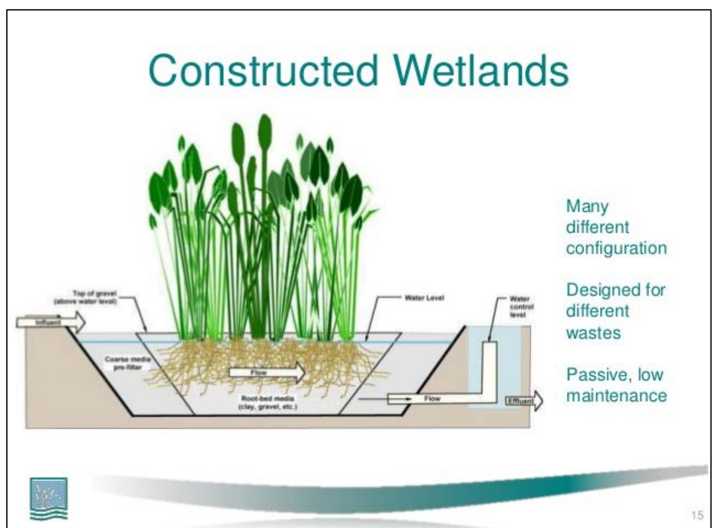
- Specific permits for reuse of reclaimed water by on-site systems (alternative systems)
  - Would require significant changes to APP general permit rules
  - Individual Recycled Water Permit always available

… BUT

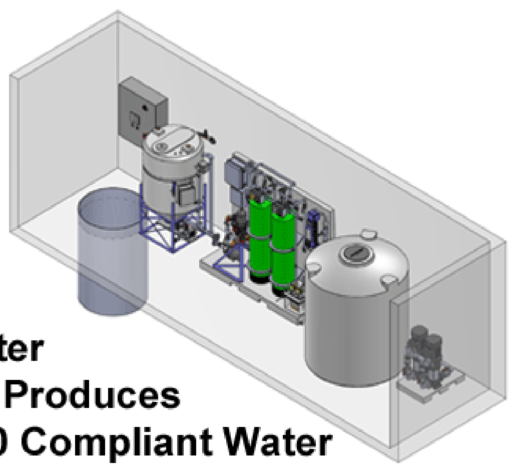
# “Reuse” general permits are already exist

- GP 4.06 and 4.07, Evapotranspiration beds
- GP 4.18, Constructed wetland
- GP 4.21, Surface disposal
- GP 4.22, Subsurface drip irrigation

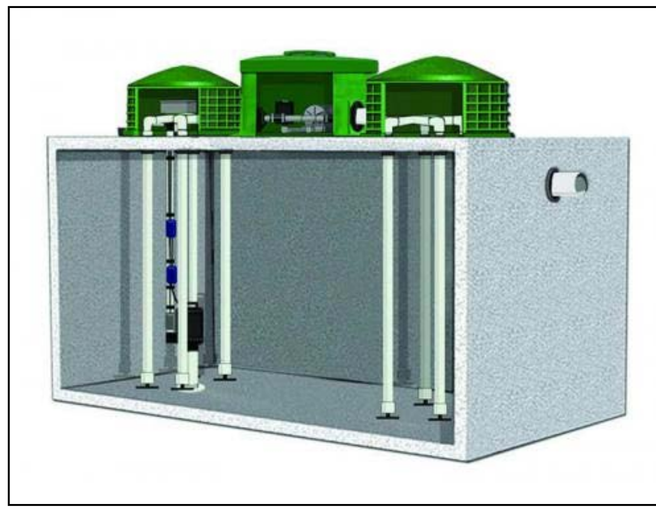


# Working Group

- ADEQ is looking at setting up a working group to recommend changes to on-site rules



Greywater System Produces NSF-350 Compliant Water



Aerobic On-site Wastewater Treatment System

US Water Alliance

WATER ENVIRONMENT & REUSE FOUNDATION WE&RF

Water Research Foundation®

National Blue Ribbon Commission for Onsite Non-potable Water Systems

## Onsite Non-potable Water System

"a system in which water from local sources is collected, treated, and used for non-potable uses at the building to district/neighborhood scale, generally at a location near the point of generation."

# National Blue Ribbon Commission

- Reports focus on guidance for:
  - Multi-family buildings
  - Commercial buildings
  - Mixed-use buildings
  - Larger complex or district-scale projects
- Likely to have a connection or access to the sewer grid
- Does not include single-family residential dwellings

## Water sources

**Blackwater**

- Toilets
- Kitchen wastewater

**Gray water**

- Showers, bathtubs
- Lavatory sinks, drinking fountains
- Laundry water

**Roof rainwater**

**Stormwater**

- overland & impervious surface

University of Arizona Water Resources Research Center, Tucson

## End uses

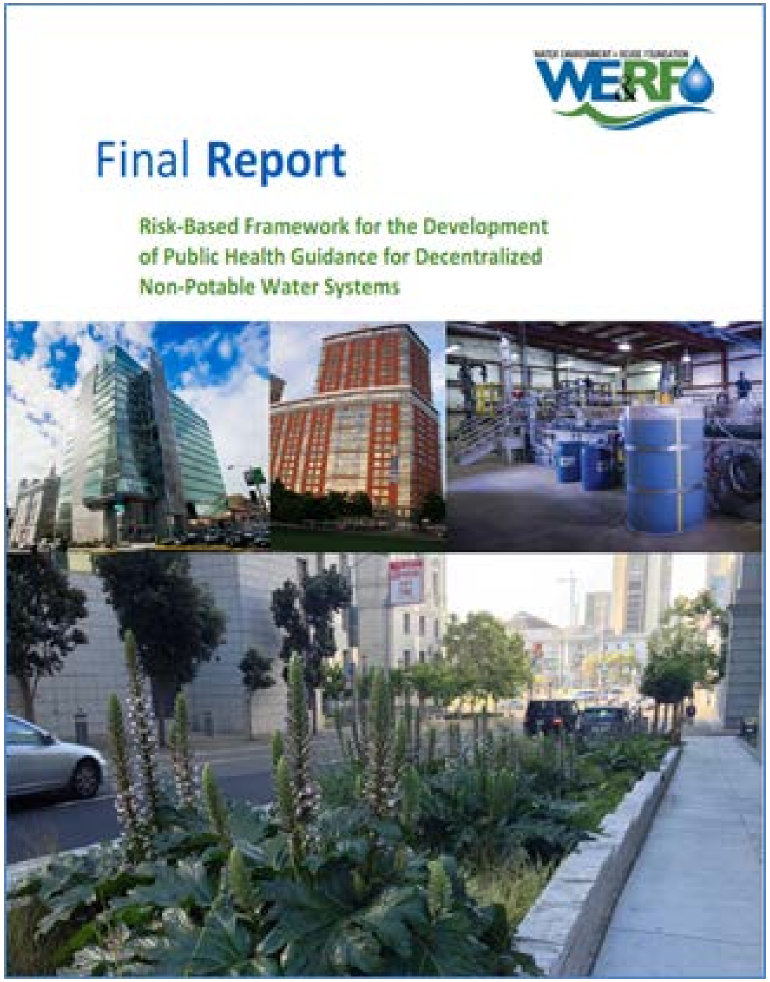
Toilet and urinal flushing

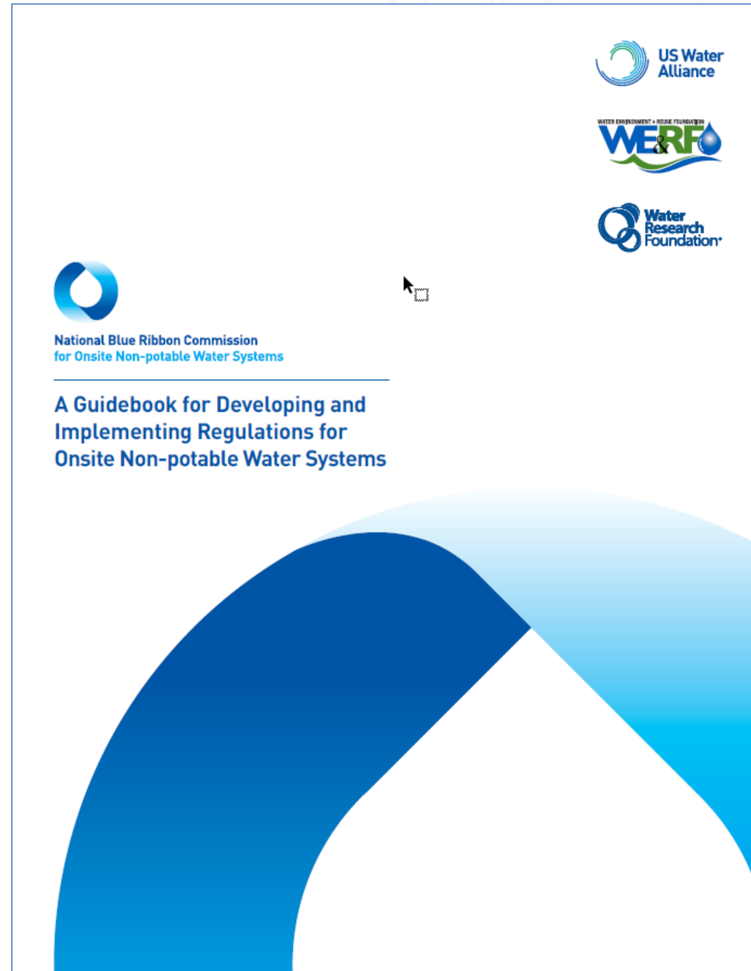
Clothes washing

Plant irrigation, unrestricted

- except food

Dust suppression


WATER ENVIRONMENT + REUSE FOUNDATION
WE&RF
Final Report
Risk-Based Framework for the Development
of Public Health Guidance for Decentralized
Non-Potable Water Systems


US Water
Alliance
WE&RF
Water
Research
Foundation
National Blue Ribbon Commission
for Onsite Non-potable Water Systems
A Guidebook for Developing and
Implementing Regulations for
Onsite Non-potable Water Systems

- Reports provide guidance on
  - Permitting
  - Water treatment standards (log reduction targets)
  - Monitoring, sampling, and reporting
  - Treatment train examples

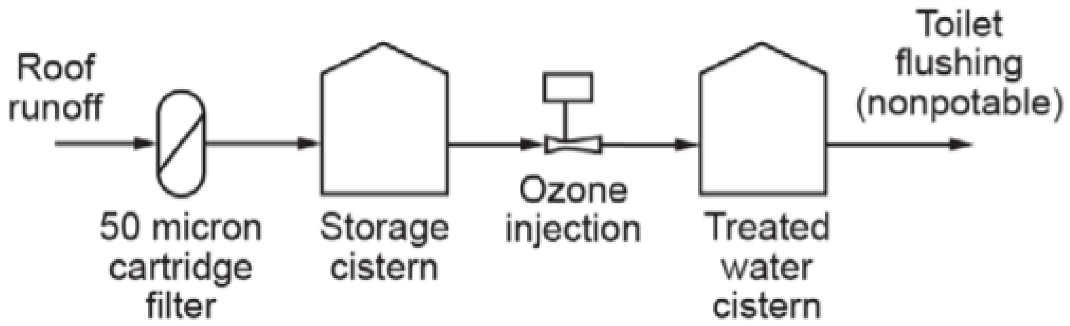



**Figure 9-1: Proposed treatment train for a roof runoff source used for toilet flushing (Example 1).**

- Challenges for implementing recommendations
  - Permits poorly specify ongoing care for monitoring, reporting, operation, and maintenance
  - Current WQ standards only apply to reclaimed water produced by a WWTP
  - Need to develop some WQ standards for specific end uses, such as toilet flushing, irrespective of source water type

# Stay Tuned on Recycled Water!

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cgg@azdeq.gov


**ADEQ Main Office, Phoenix**

# Drinking Water Treatment Comparison

ADEQ
Arizona Department of Environmental Quality

| | Surface Water Treatment Plant | DPR Advanced Water Treatment Plant |
|---|---|---|
| **Source Water Quality** | Highly variable (sediment, microbial quality, etc.) | Consistently good Class A+ Reclaimed Water (low turbidity, no *E. coli*) |
| **Treatment** | (1) Coagulation, flocculation, sedimentation; (2) Filtration; (3) Disinfection | + MF or UF, RO or GAC-BAC, and UV-AOP |
| **Treatment Effectiveness** | No special targeting for microbial & chemical ECs | Multiple treatment train processes target removal of microbial & chemical ECs |
| **Unit Process Control Monitoring** | Grab and composite sampling to ensure effectiveness; delay in response | Comprehensive real-time monitoring of critical control points throughout treatment train |
| **Public Health Monitoring** | One *E. coli* sample per day | + Real-time monitoring with multiple, sophisticated instruments |
| **Out-of-limit Response Time** | 1-2 days (after *E. coli* resample) | Near-immediate response |
| **Type of Response** | Boil order | Rapid diversion of out-of-spec water |