Recycled Water in USEPA Region 9

Bruce A Macler, PhD
USEPA Region 9
415 972-3569
macler.bruce@epa.gov

Bottom Line: USEPA's Views on Water Recycling in R9

- Wastewater can be recycled safely, even for potable purposes
- Much opportunity: use of treated wastewater varies from only ~15% in CA and NV to ~80% in AZ
- Most recycled water is used for non-potable purposes, like agriculture and landscaping
- Substantial indirect potable reuse, though
  - Groundwater recharge
  - Surface water disposal ("de facto" potable reuse)
- In CA, of ~2.3 BGD total treated wastewater, about 1 BGD is merely piped to the ocean
  - Wasted resource
  - Good opportunity for new projects

Uses for Recycled Water

- **Urban**: recreational fields, golf courses
- **Agricultural**: food crops, non-food crops, livestock watering
- **Impoundments**: recreational water bodies, landscape features, snowmaking
- **Environmental**: wetlands (habitat, fisheries, recreation), flow augmentation, ecological benefits
- **Industrial**: cooling towers, boiler water, oil/gas production, food manufacturing, high-tech
- **Groundwater recharge**: salinity barriers, "non-potable" potable
- **Drinking water**

Recycling for Human Consumption: "Potable Reuse"

- Much wastewater is treated and disposed into surface water bodies
- It is often in a source of drinking water of downstream communities
  - Dilution counts for something, but variable
  - Maybe some additional microbial inactivation
- "Indirect potable reuse" specifically addresses wastewaters purposely recycled for drinking water
  - Higher levels of treatment
  - Environmental buffers (groundwater recharge, surface augmentation)
- "Direct" potable reuse skips the environmental buffers

Federal Regulatory Requirements for Water Recycling

- No direct requirements governing recycling
  - No prohibitions
- Clean Water Act governs discharge of wastewater to receiving bodies to protect beneficial uses through NPDES permits
  - Usually, just secondary treatment
- Safe Drinking Water Act governs quality/safety of water to the consumer
  - Maximum Contaminant Levels apply to finished water
  - Surface Water Treatment Rules have some source water quality components that govern treatment requirements
- Current Agency thinking is potable reuse goes under SDWA

The Safe Drinking Water Act

- Federal law to protect public from drinking water contaminants of health concern
- Adopted 1974
- Significant amendments in 1986, 1996
- 1986 amendments had explicit, stringent health goals and risk management approaches

The Safe Drinking Water Act Directs EPA's DW Regulations

- Maximum Contaminant Level Goals
  - **Not enforceable, but direct MCL selection**
  - **"Each MCLG…shall be set at the level at which no known or anticipated adverse effects on the health of persons occur and which allow an adequate margin of safety"**
- National Primary Drinking Water Regulations
  - **Enforceable**
  - **Set as close as feasible to MCLGs**
  - **Feasible analytical methods and treatment technologies**
  - **Administrator can adjust MCL for cost reasons**

How Safe is the Water? Risks and "Regulatory Risks"

- What is risky is in the eyes of you, the consumer
- Risks that produce health effects that a medical doctor can see are usually >1 person in 100
  - Smoking -> lung cancer ~1/10
  - Driving -> dying in car accident ~1/200
  - Waterborne disease outbreak ~1/5
- Drinking water regulations require risks below detection, ~1/10,000 to 1/million

EPA Public Health Goals for DW Chemical Contaminants

- For contaminants with no threshold for adverse effects (genotoxic carcinogens)
  - **MCLG = 0**
  - **MCL generally set between 1/10,000 and 1/million increased lifetime risk, based on risk assessments**
- For contaminants showing a threshold for adverse effects (cytotoxic carcinogens, non-carcinogens)
  - **MCLG based on Reference Dose (RfD), set to be below any known adverse health effects**
  - **MCL set as close as feasible to MCLG**

Drinking Water Risk Assessments

- USEPA DW risk assessments designed to find "zero" risk, to determine MCLG
  - "Regulatory risk" assessment
- Extrapolate data from known risks at higher exposures to estimate zero risk exposure level
- Generally lack complete information
- Use conservative assumptions, not averages
- Thus, real risks may be over-estimated
- Can't be used to predict actual illness rates

Health Risks From Recycled Water

- Pretty much anything in wastewater could be in most water sources
  - Pathogens
  - Toxic organic and inorganic chemicals
  - Radioactive materials
- The issue is mostly whether the treatment gets these out
  - For almost everything we know about, the answer is yes.
- There are some concerns for treatment byproducts
  - Transformed chemicals
  - Byproducts of disinfection
- And concern for the “unknown unknowns”

Recycling Treatment Processes

- **Wastewater**
  - Primary: removal of settled and floating materials
  - Secondary: biological oxidation to remove organics
  - Tertiary: filtration, disinfection
  - Advanced tertiary: oxidation (ozonation, UV/peroxide), reverse osmosis treatment to remove trace chemicals, denitrification/nitrification
- **Drinking water**
  - Coagulation/flocculation/sedimentation
  - Filtration
  - Disinfection

Typical Potable Reuse Treatment Criteria

- Advanced tertiary treatment of wastewater
  - Oxidation, microfiltration, reverse osmosis, UV/peroxide or ozone oxidation, disinfection
- For indirect potable reuse, add
  - Groundwater recharge, residence for some time (months)
  - Surface water augmentation, 1:10 dilution, residence for ~six months
- Then, conventional drinking water treatment
  - Flocculation/coagulation, sedimentation, filtration, disinfection
  - Often, advanced disinfection (ozone, UV)

Public Health Concerns for Potable Reuse

- Catastrophic failure of much or all of treatment train, allowing sewage to reach public
  - Multiple independent treatment elements
  - Adequate time from detection to control
- Treatment-resistant contaminants of known health concern
  - Monitoring against risk benchmarks
- Unknown contaminants of health consequence

Waste Not, Want Not: Opportunities for Additional Water Recycling

- It is said that in inland areas, much wastewater is minimally treated, then evaporated by spraying or spreading on land in lagoons
  - NPDES program has compliance issues with some of these systems
- As noted, in coastal areas, much water is treated and disposed in the ocean
- Both situations result in water lost to any beneficial purpose
- Many non-potable beneficial applications only require additional disinfection
  - Where salt or trace contaminants are not issues

Whose Wastewater is It, Anyway?

- POTWs have traditionally been doing a service to the public
- But treated wastewater can be considered a resource or commodity
- POTWs can become businesses selling recycled water
- But maybe others should have a say in allocating this water? Especially if public funds are subsidizing it?

Disincentives to Recycling

- Continued availability of free or cheap water
- Lack of money for infrastructure, O&M
- Lack of appropriate distribution systems
- Regulatory hassles and delays

So How Much Water is Recycled in R9?

- Limited data are available on water recycling in Region 9 states
  - WateReuse Association maintains a database on purposeful recycling, gathered from their surveys
  - Data are outdated, for only one or a few years, and inconsistent. True numbers likely to be higher…
  - Data do not include treated water returned to environment
- California: 221 systems, 218 billion gallons recycled (2009)
  - 13% of treated wastewater
- Arizona: 180 systems, 62 B gallons recycled (2012-2013)
  - 82% of treated wastewater
- Nevada: 5 systems, 6.7 B gallons recycled (2011)
  - 15% of treated wastewater

Recycled Water Uses in R9

- California
  - Largest use for reused water is for agriculture (36%, 79 BGY)
  - Landscape and golf course irrigation (23%, 50 BGY)
  - Groundwater recharge/ seawater barriers (19%, 42 BGY)
  - Industrial uses 10%, 21 BGY).
- Arizona
  - Largest uses are for power generation and agriculture (each 27%, each17 BGY)
  - Groundwater recharge (26%,16 BGY)
  - Surface water augmentation (13%, 8 BGY)
  - Landscape irrigation (7%, 4 BGY)
- In Nevada, most is for public landscape irrigation (85%, 6.0 BGY)