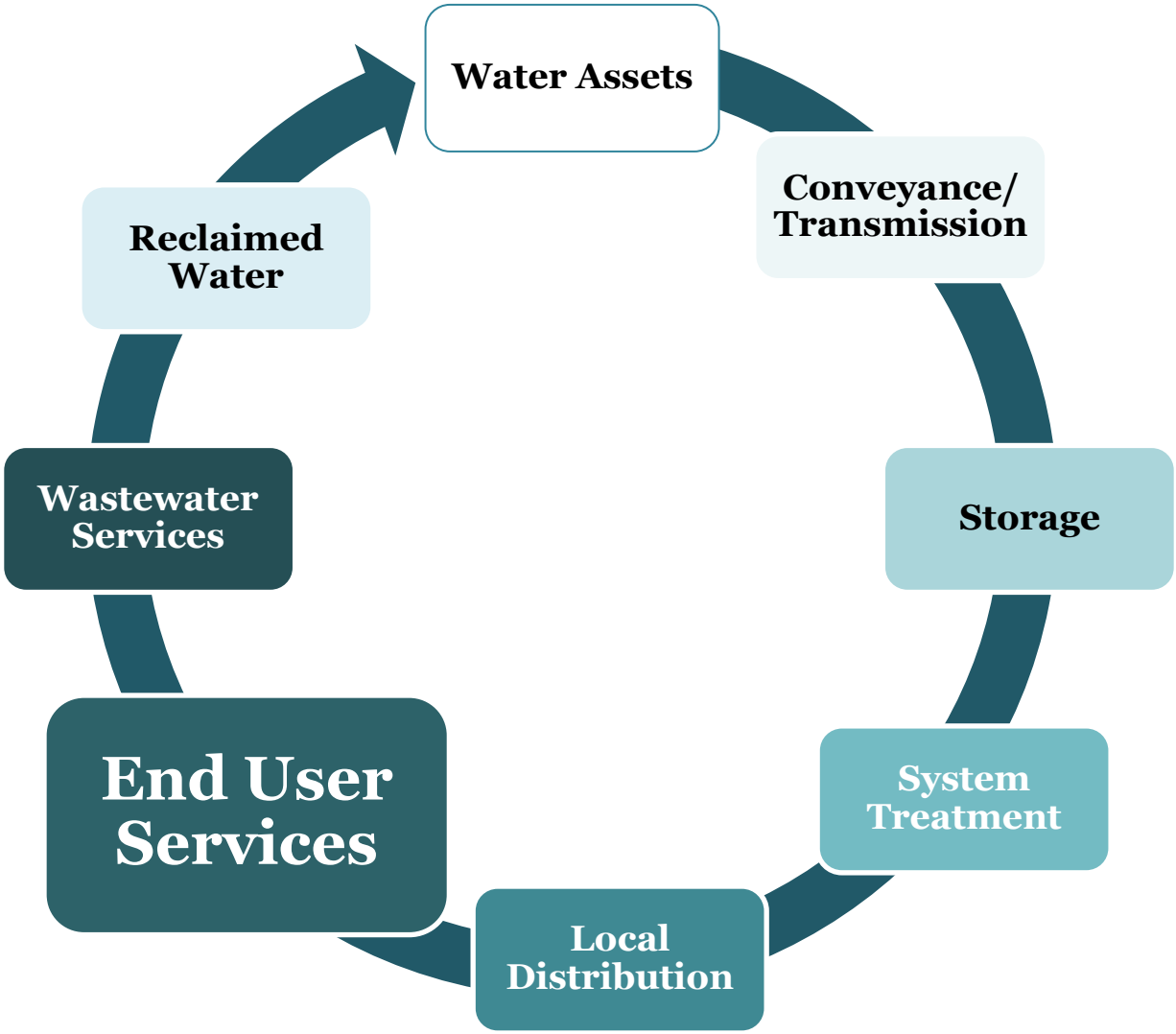
The Impact of Self-Regenerating Water Softeners on Water Management

Multi-State Salinity Coalition

February 20, 2015

Las Vegas, NV

THE WATER VALUE CYCLE



Residential End User Services

- Many homes use water treatment solutions
  - For contaminant reduction
  - For convenience & personal preference
  - To protect the investment in their home
- 2 categories
  - Point of entry (POE) treats all water going into the home
    - Water softening
    - Whole house filtration
  - Point of user (POU) treats water for drinking
    - Under sink reverse osmosis (RO)
    - Flow through filtration
    - Ionizers/alkaline water

Commercial End User Services

- Nearly all commercial/industrial end users treat water in some way
  - To assure that their equipment works properly and to lower maintenance costs
  - To assure that the water meets their production requirements
- POE
  - Water softening
  - Filtration
- POU
  - Process water
  - Drinking water systems
  - Wastewater treatment

US Residential Water Treatment Industry*

• Softener Equipment	$800,000,000
• Softener Service & Finance	$3,400,000,000
• RO Equipment	$250,000,000
• RO Service & Finance	$2,500,000,000
• POU Carbon Filter Equipment	$100,000,000
• POU Carbon Spares	$40,000,000
TOTAL	$7,090,000,000
Reference Points	
• Municipal Water Sales	$40,500,000,000
• Bottled Water Sales	$11,000,000,000

*Andrew Warnes – Who will win the US residential water treatment market wars
PENTAIR

The Residential SRWS Market

- US Market – POE
  - 900,000 +/- water softener valves are sold each year
  - 5-10,000,000 +/- installed base
- International market
  - 850,000 water softeners sold last year split almost evenly between Asia Pacific, Europe, & Middle East
  - Drinking water market is HUGE

Scoures: Frost & Sullivan and Andrew Warnes, Clack Corporation & Hydronovation Inc.

US Water Hardness

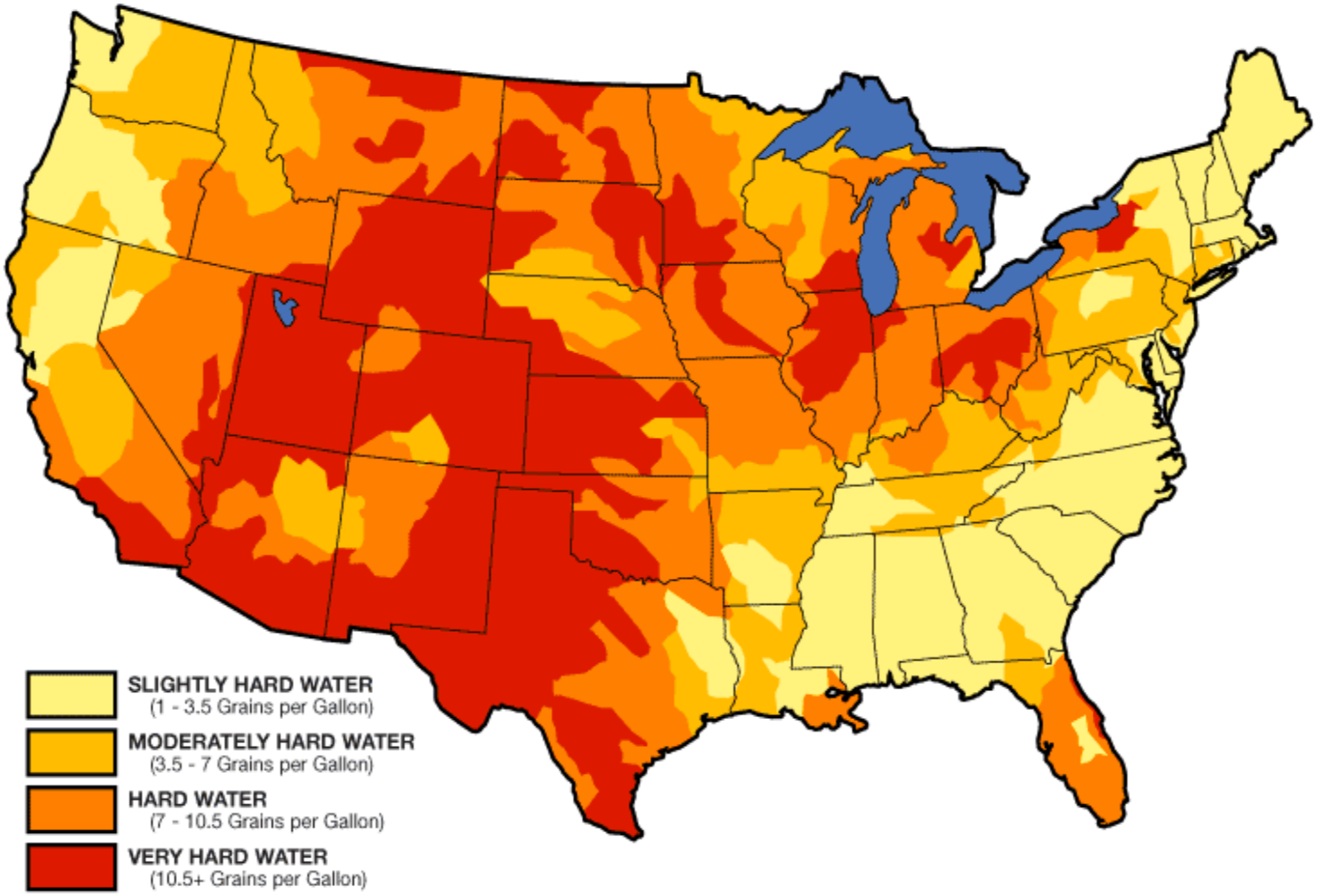


Table adapted from and prepared by the United States Geological Survey

Water Softening Trends

- 89% of US homes have hard water supply
- Self-regenerating water softeners (SRWS) are by far the most prevalent “softening” technology
- New technologies are emerging
- “Brine restrictions” are being enacted

Why Soften Water

Benefits to Homeowners & Businesses

Benefits of Softened Water

- Economic Benefits
  - Protects plumbing, plumbing fixtures and water using appliances – residential, commercial, HVAC systems and more
  - Lowers the cost of heating water
  - Spend less on cleaning supplies
- Aesthetic Benefits
  - Eliminates spots on dishes
  - Gets clothes cleaner with less cleaning supplies
  - Hair is “shinier”
  - Skin feels smoother

Soft Water, Water Heaters and Water Using Appliances

- Heating water is the SECOND biggest user of energy in the home
- Consumers are switching to more energy efficient heaters to cut energy costs
- Manufacturers of water using appliances recommend that consumers use soft water – some even VOID their warranty if used on hard water

http://www.wqa.org/detergent/SWB_Studies.pdf

Battelle Findings About Hard Water & Water Heater Efficiency

- Water heaters on soft water maintained factory efficiency ratings whereas those on hard water dropped rapidly
- Gas water heaters:
  - Hard water resulted in as much as a 25% loss of efficiency
- Electric water heaters showed a similar loss of efficiency
- Tankless water heaters:
  - Failed after only 19 days of testing
  - Water heating efficiency dropped by 10% in less than 2 years
  - Operating costs were 47% less when using soft water

http://www.wqa.org/detergent/SWB_Studies.pdf

Softwater Saves on Cleaning Expenses

- The average family spends a lot of money each month on soaps and cleaning aids for the home and personal grooming
- Much of the soap chemistry is “softening agents” to counteract hard water
- Soft water reduces usage of these products by as much as 75%
- Clothing and other textile life is prolonged by up to 15% when washed in soft water
- The typical homeowner spends more than 6 hours a month cleaning water spots, streaks and removing scum
- Softened cold water produced better cleaning results than hard hot water with 50% soap dosage

http://www.wqa.org/detergent/SWB_Studies.pdf

Showerheads

- Showerheads become unusable within months
- Low flow showerheads on hard water lost 75% of their flow in just 18 months

Figure 6-5D. Showerhead 5 on seventh day of testing with soft well water (<1 grain per gallon) showing spray pattern. Battelle testing for Water Quality Association. May 1, 2009

Figure 6-10D. Showerhead 10 on seventh day of testing with hard well water (28 grains per gallon) showing spray pattern. Battelle testing for Water Quality Association. May 1, 2009

http://www.wqa.org/detergent/SWB_Studies.pdf

Water Softening Options

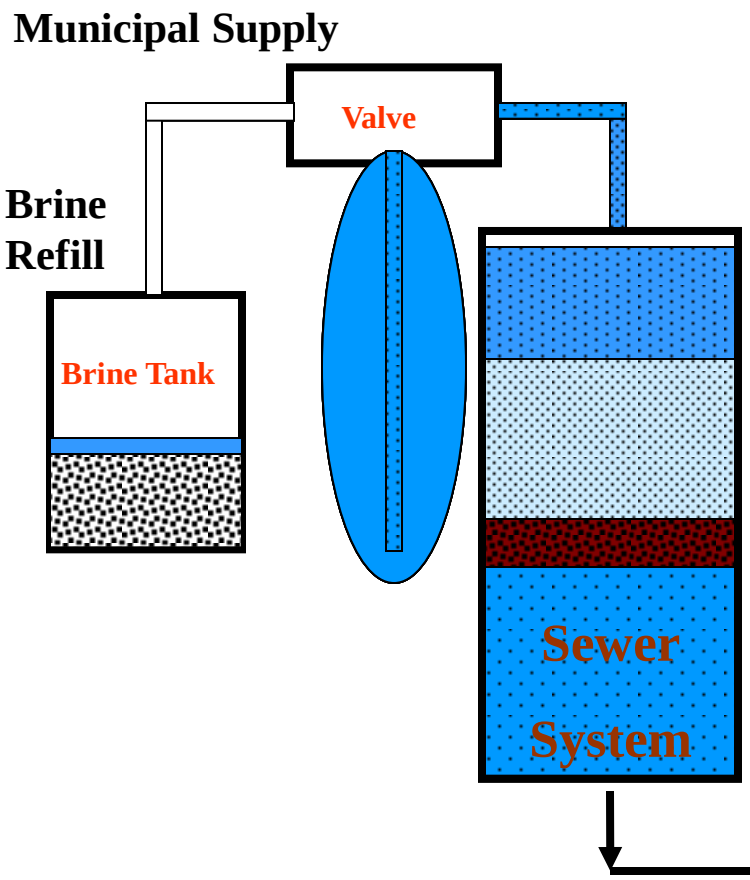
- SRWS – DIR, time clocks, proportional brining, up-flow regeneration
- Portable Exchange Tank Service (PE)
  - Off site regeneration
  - No salt or water used on site
  - Zero Liquid Discharge regeneration is possible in PE
- RO – “whole house RO” is growing trend in residential softening
  - 50% or more of the water is “rejected”
  - Need to “re-purpose” this to on-site irrigation
- Electrochemical De-ionization
  - No chemicals
  - 70-80% “efficient”
  - 70-80% hardness reduction
- Other devices are not “water softeners”

But Brine From SRWS is a Problem

- A typical residential SRWS (1 cubic foot of resin) uses:
  - 50-85 gallons of water used EVERY regeneration
  - 20-30 gallons contains all the salt – but it pollutes all of the wastewater
  - 6-15 pounds of salt used EVERY regeneration
  - Typically regenerate 2 or 3 times per week
- Commercial
  - Big systems – multiple cubic feet of resin
  - Duplex & triplex systems
  - Salt dosage is typically higher to get a more complete regeneration to protect against “leakage”

Typical SRWS Operation

- Typical SRWS Operation
  - 50.8 gal/regen (as much as 85 gal/regen)
  - <15 # salt/regen



Fast Rinse = 11.4 Gal.

Slow Rinse = 26.4Gal.

Heavy Brine = 4 Gal.

19 Gal. = Resin Bed Backwash

SRWS Reserve Capacity

- Programmed with a “reserve capacity” so you don’t run out of softwater
- Regenerate before using the entire bed
- Can be as much as 1/3 of the bed capacity on smaller systems
- Better systems “calculate” daily water usage and “adjust” the reserve
- Bigger systems use a smaller percentage of resin volume as reserve
- Results in less salt and water use

Salt Dosage vs. Water Usage & Resin Volume – ¾ Cubic Foot SRWS

3/4 cubic foot unit			
Salt dosage # /ft^3	5	10	15
Salt dosage# /¾ ft^3	3.75	7.5	11.25
# people	3		
gallons/person/day	75		
gallons/day	225	225	225
hardness	15		
grains/day	3375	3375	3375
capacity w/reserve	15,000	21,000	24,000
days to regen	2.5	3.5	4.0
regens/year	146	104	91
gallons/regen	40	42	44
Σ gallons/year	5840	4368	4004

Salt Dosage vs. Water Usage & Resin Volume – 2 Cubic Foot SRWS

2 cubic foot unit			
Salt dosage # 1ft³	5	10	15
salt dosage#/2ft³	10	20	30
# people	3		
gallons/person/day	75		
gallons/day	225	225	225
hardness	15		
grains/day	3375	3375	3375
capacity w/reserve	40,000	56,000	65,000
days to regen	9.8	13.8	16
regens/year	37	26	23
gallons/regen	85	90	100
Σ gallons/year	3145	2340	2300

SRWS Bring Discharge & Wastewater Treatment & Recycling

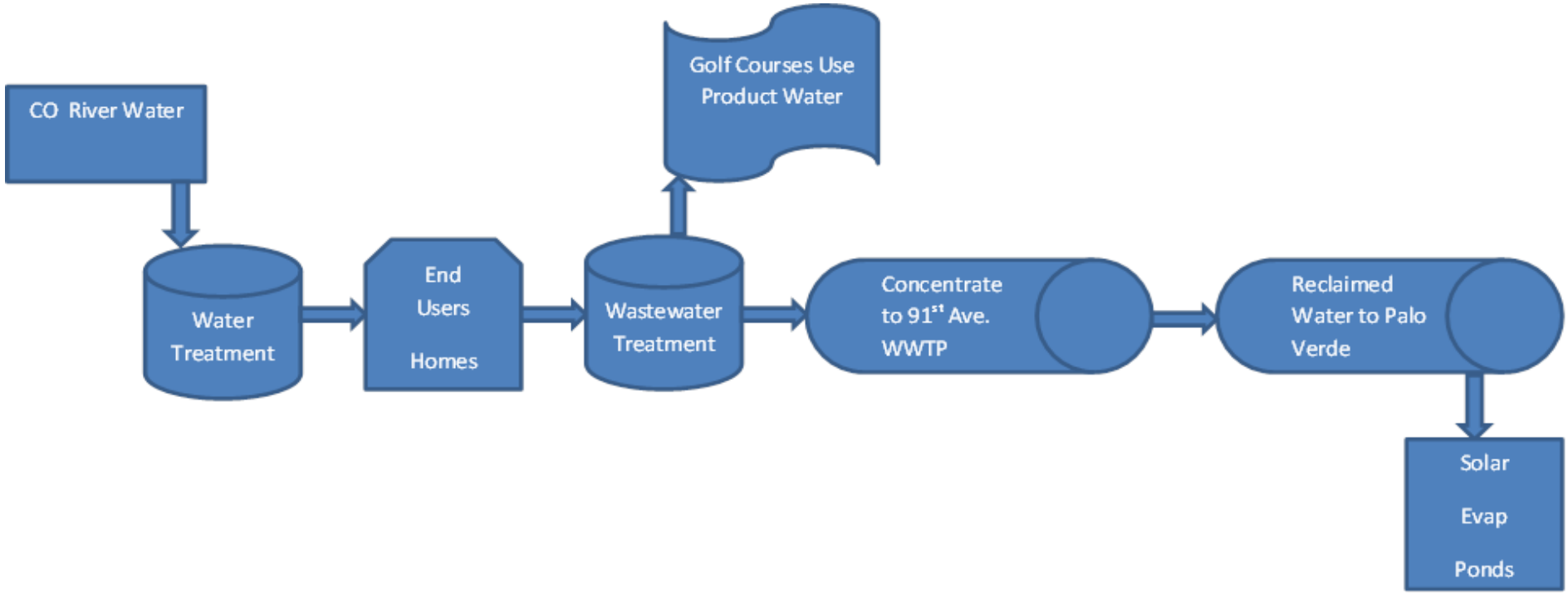
Controlling Salt Discharge From SRWSs

The use of residential self-regenerating water softeners to treat water hardness is one of the contributing factors to high levels of salinity in our water supplies.

Controlling all sources of salinity is necessary to protect water quality – and ***residential self-regenerating water softeners are considered a leading controllable source of salinity***.

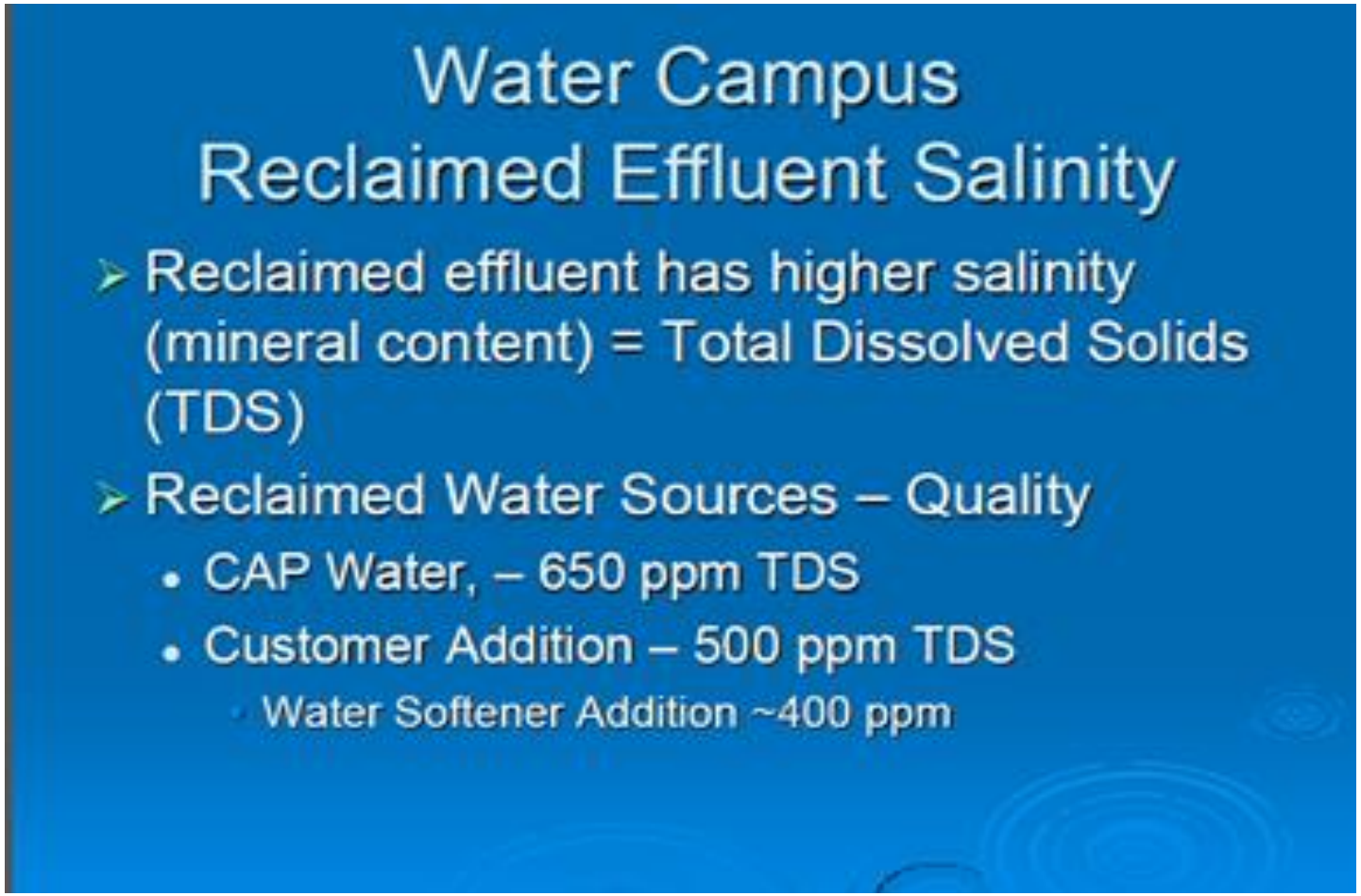
http://www.socalsalinity.org/pdfs/SCSCFactSheetonSalinityandWaterSoftenersAugust2009.pdf

Water is “Softened” 3 Times in the Phoenix Area



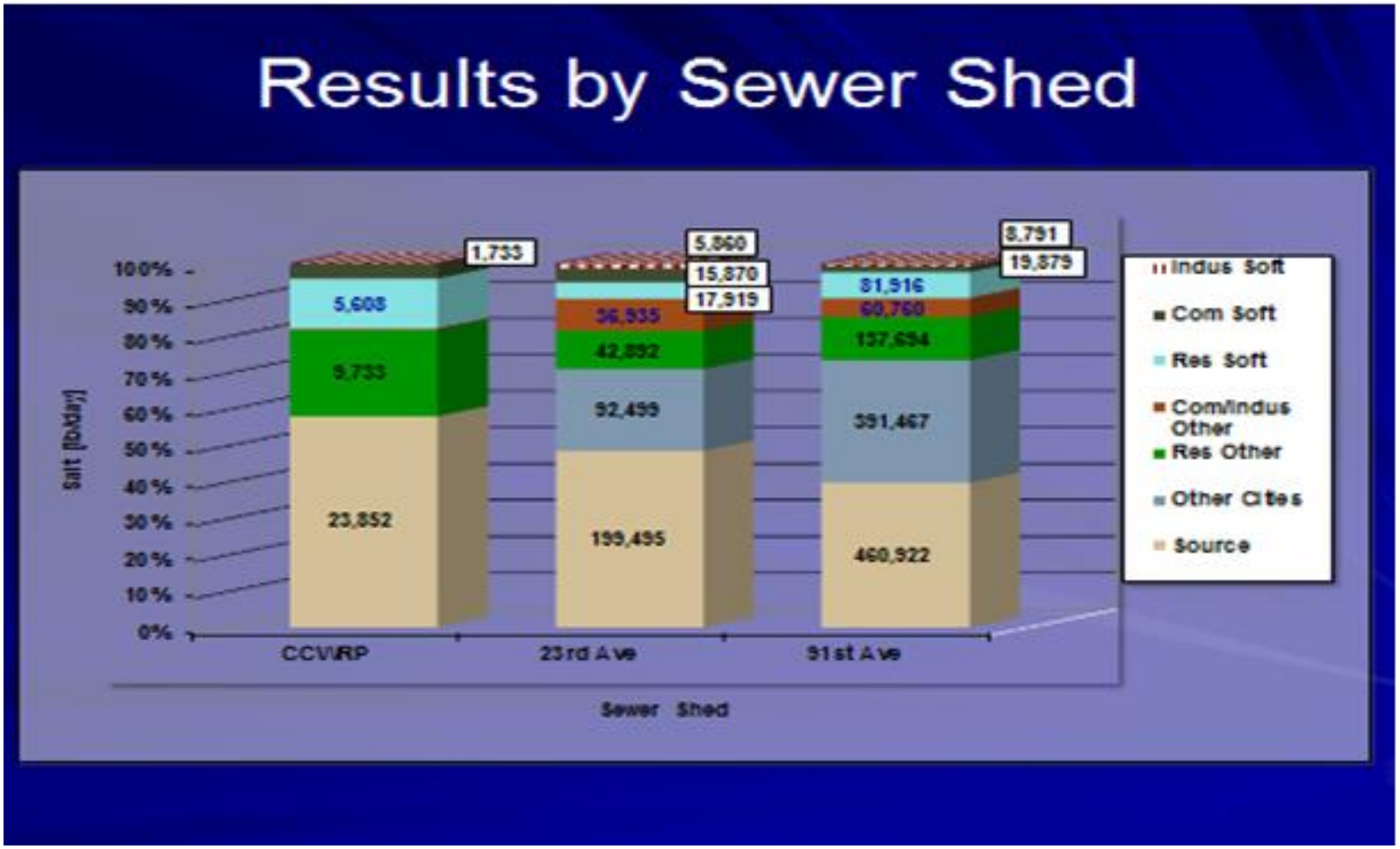
1. In the home / business
2. At the wastewater treatment / water reclamation Plant
3. At the Palo Verde Nuclear Power Plant

Scottsdale – Salinity Sources in Wastewater



Slide from a presentation by Marshall Brown then Director of Scottsdale's water department at the Water Quality Association "salinity summit" in Scottsdale in April of 2012.

Phoenix WWTP Salinity Sources



Slide from a presentation by Becky Kelso, City of Phoenix Water Services Department at the Water Quality Association “salinity summit” in Scottsdale in April of 2012.

San Antonio Water Systems (SAWS)

- Annual water usage is 204,000 acre feet
- TDS is 242-356 ppm

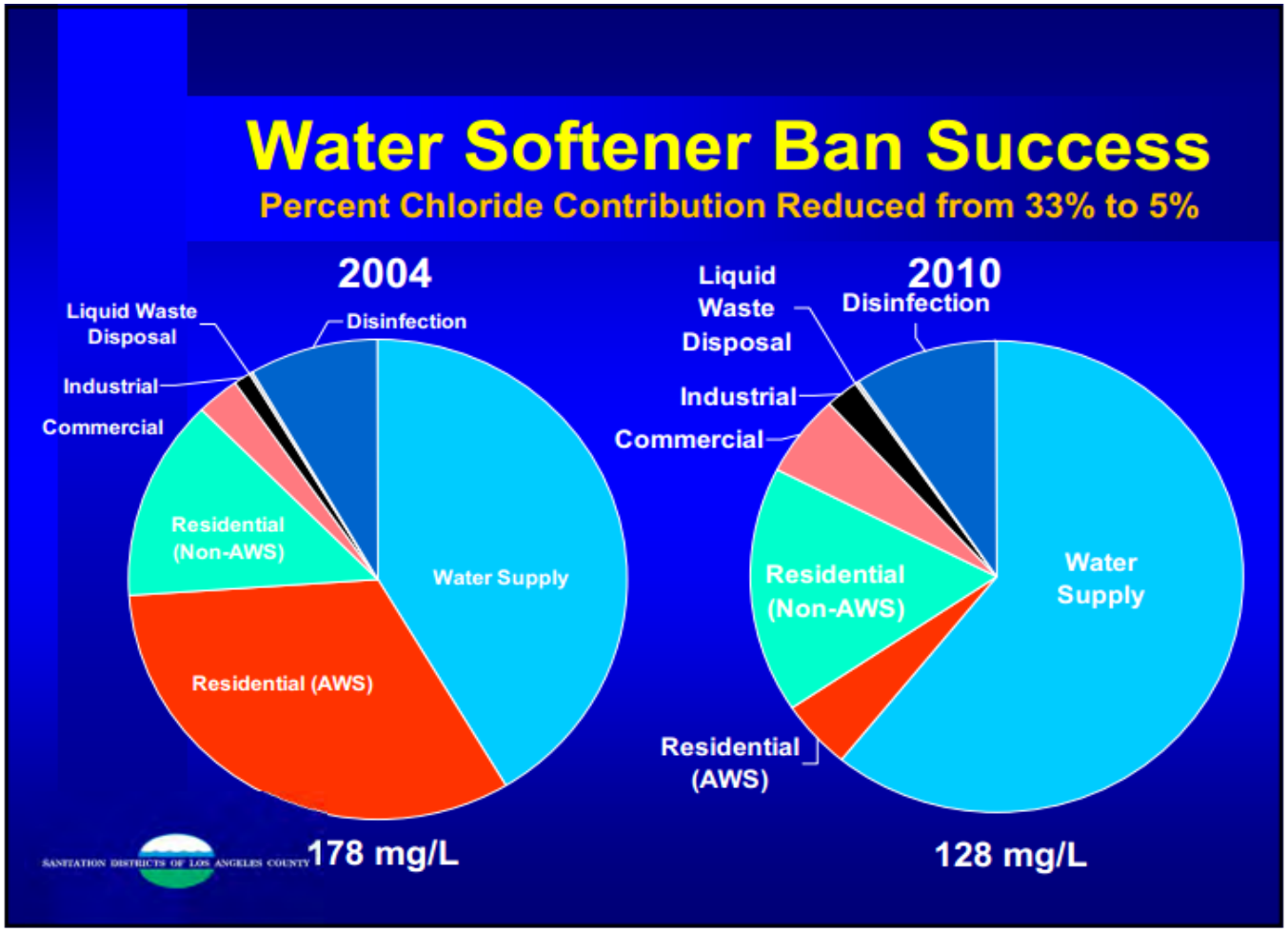
https://www.saws.org/your_water/waterquality/report/docs/2012_WaterQualityReport.pdf

- Typical hardness is 15-20 grains / gallon (256-342 ppm of hardness)

http://www.saws.org/environment/ResourceProtComp/groundwater_protection/water_quality/faqs.cfm

- Estimate is 1/3 of homes have SRWSs
- TDS in wastewater is 700+/-

LA San District Santa Clarita SRWS Ban & Mandatory Removal



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Salinity Control Strategies / Options Related to SRWS Brine Reduction

- Salt “source control” – allow SRWSs but not brine discharge
- Prohibit SRWSs
- Can be done in:
  - CC&Rs
  - The building code
  - Local ordinance
  - State law
  - “Will serve” agreements with developers

Salinity Control Programs

- CA – requires “high salt efficiency” demand initiated SRWSs
- Santa Clarita, CA
  - Ban on installation of new SRWSs
  - Incentives to remove old softeners, including rentals
  - Passed a referendum requiring removal of all softeners
  - Up to $1,000 fine and 30 days if you have a SRWS now
- Mountain House Community, CA – CC&As require “there shall be no disposal of … the salts from soft water systems within the community”

Salinity Control Programs

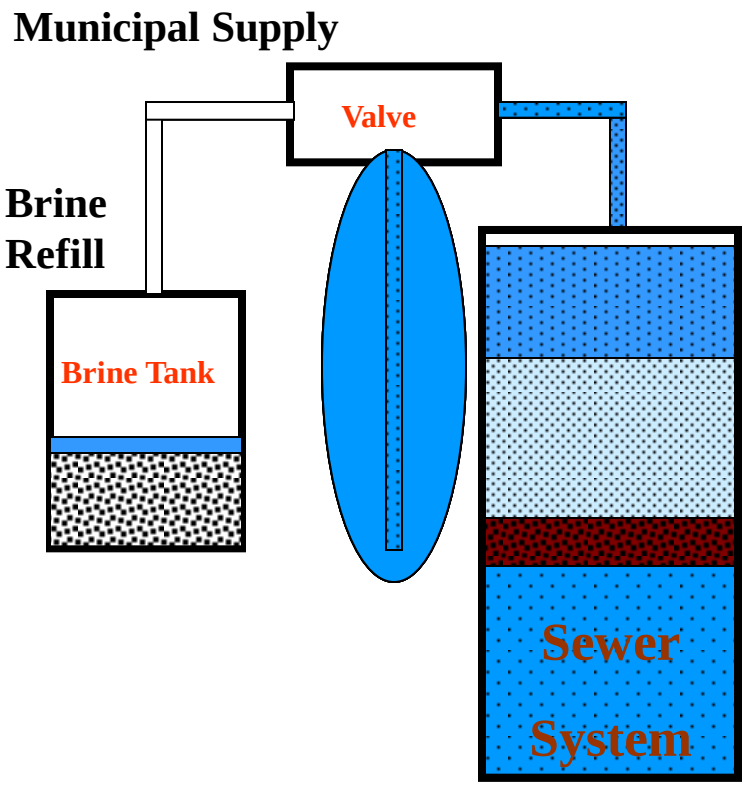
- Inland Empire Utilities Agency, CA
  - Ban on installation of new SRWS
  - Up to $2,000 incentive to remove an existing SRWS
- Hollister, CA is the latest to ban SRWS installations
- Scottsdale offering incentives to:
  - Remove an old SRWS and replace with a “high efficiency” SRWS
  - Remove a SRWS and replace with PE
  - Remove a SRWS and go without an ion exchange based soft water system

What is the Solution

- Don’t deny the benefits of softened water
- SRWSs are robust, inexpensive and effective
- Control brine don’t ban SRWSs
- 20-30 gallons per cubic foot of resin contains all of the salts
- Divert and manage brine at the source
- Benefits of softened water are still available to homeowners & businesses

Typical SRWS Operation

- Typical SRWS Operation
  - 50 gal/regen (as much as 85 gal/regen)
  - <15 # salt/regen



Fast Rinse = 11.4 Gal.

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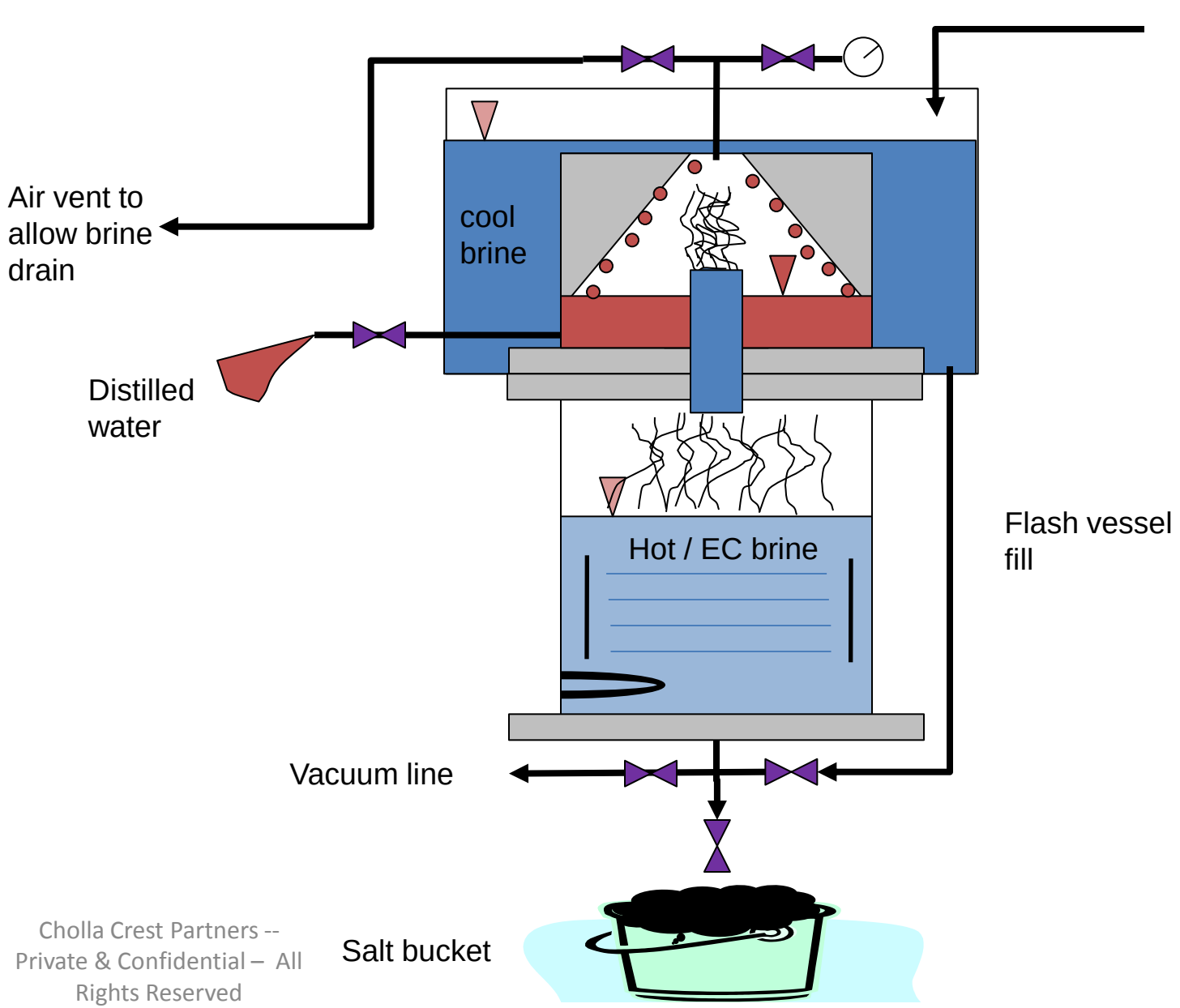
Divert highest saline water to the SALT MINER

19 Gal. = Resin Bed Backwash

The SALT MINER Applied to SRWS Brine



The Bottom Line

How Much Salt Is Discharged By SRWSs?

Impact of SRWSs in the Lower Colorado River Region

SRWS Waste Water & Salt Calculations

	# SRWS	# Regens / year	Gal/Regen	Gal. Used in Regen	Acre Feet	Salt dosage	# Salt
	3,634,500	122	50	22,170,452,440	68,039	10	4,434,090,488
	3,634,500	183	50	33,255,678,660	102,058	6	3,990,681,439