

A Path To Water Resilient Facilities

Water Efficiency Technologies

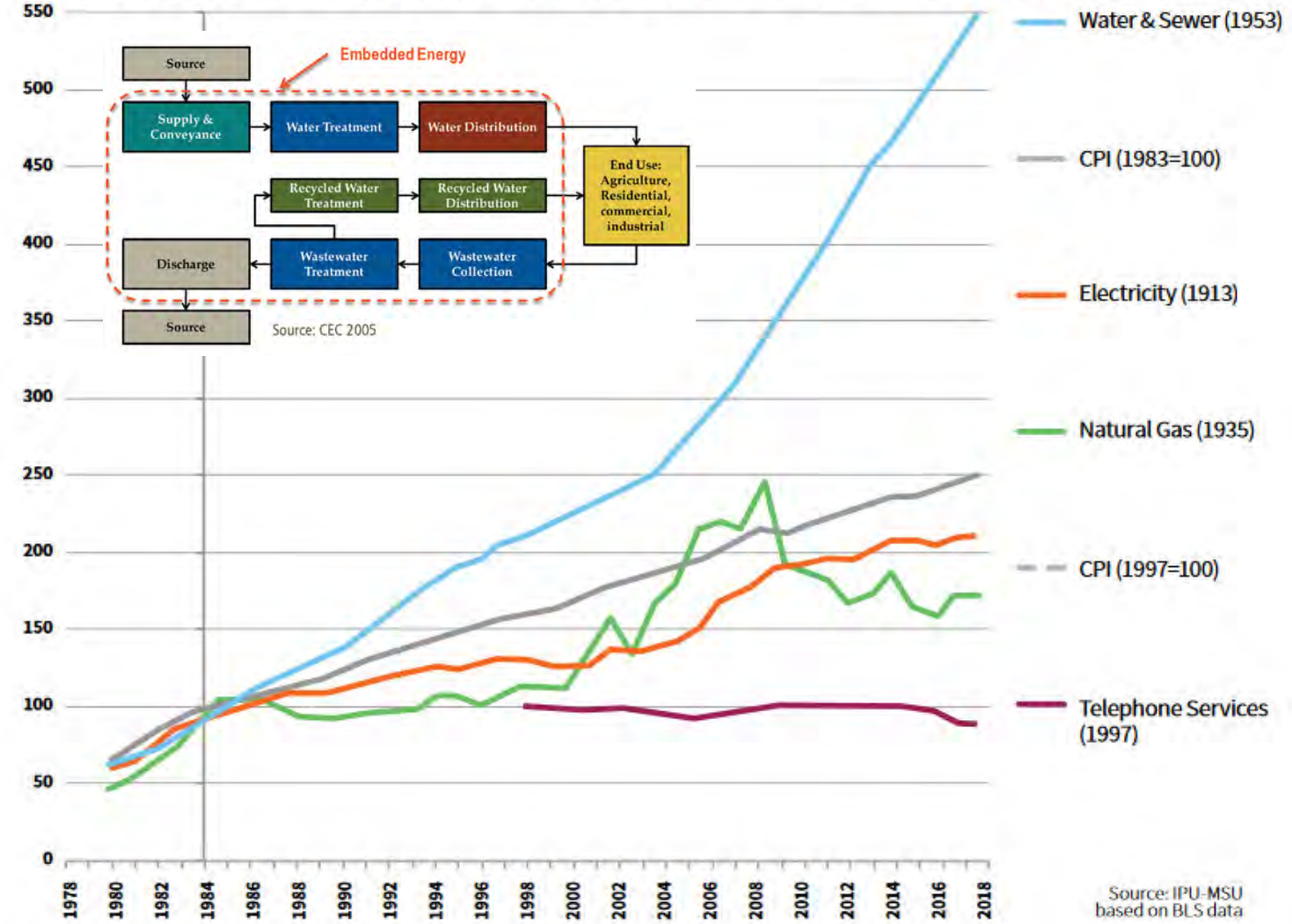
Edward J. Brady CEM, LEED-GA, ARCSA-AP



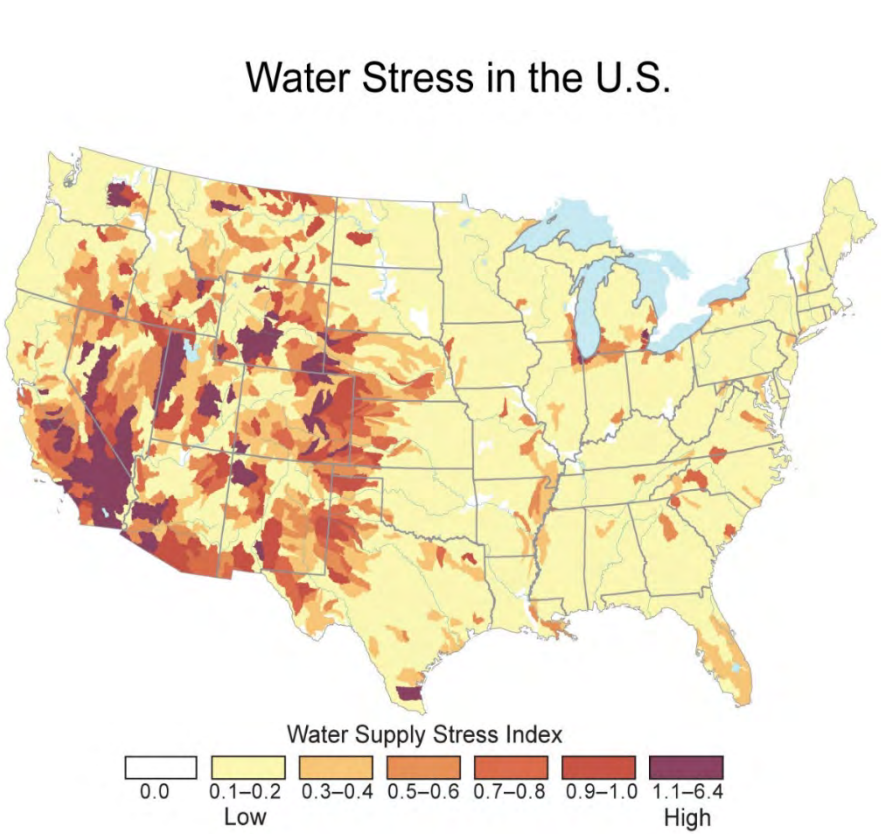
November 2020

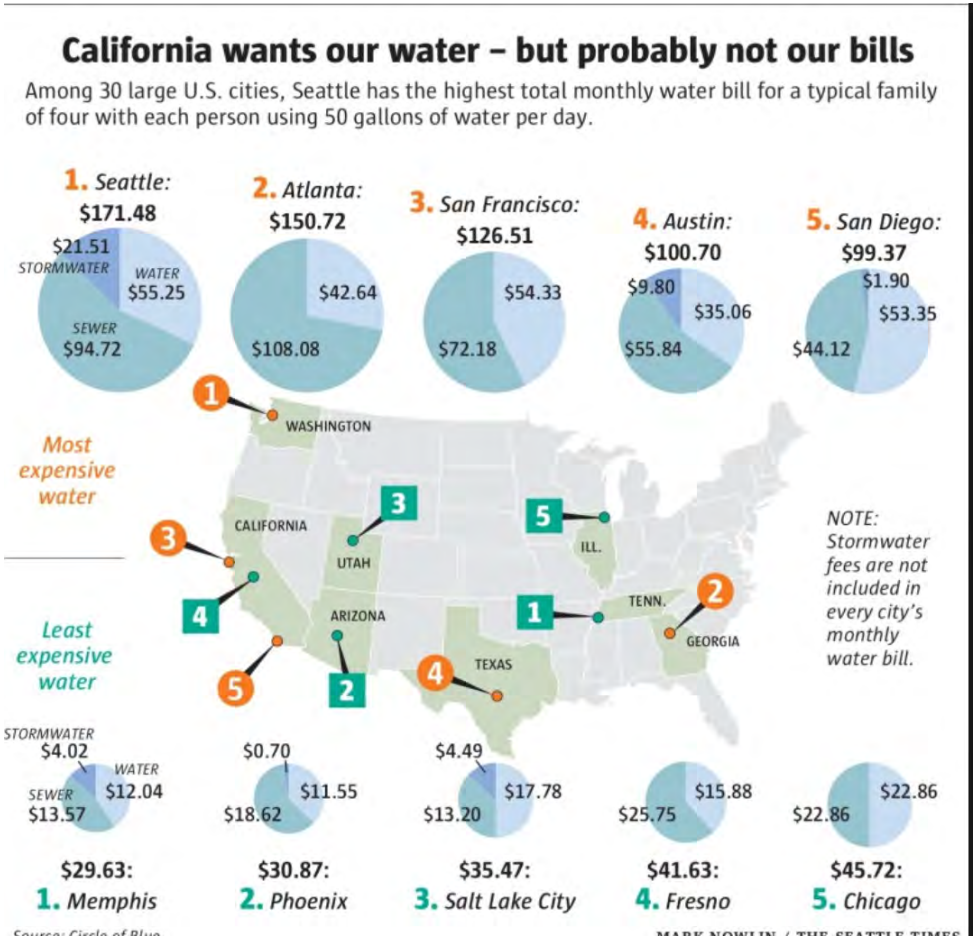
"Water Is Free" – Correct?

FIGURE 1. CONSUMER PRICE INDEX TRENDS FOR UTILITIES IN THE UNITED STATES

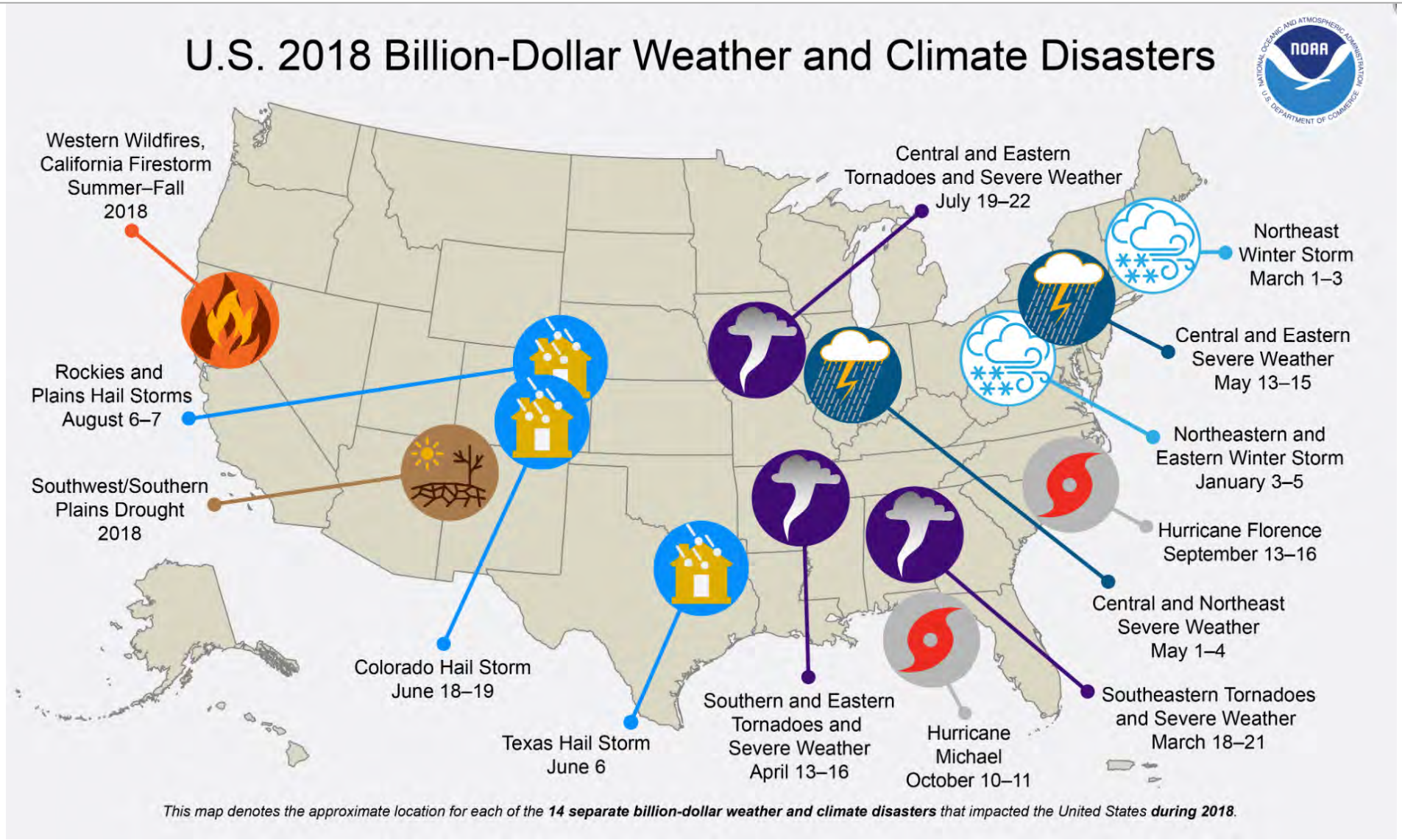


Drivers for Rate Increases





2018 Disasters (Weather/Climate Related)



Visible and Dangerous Events Caused by Droughts and Lack of Ground Re-Charge

California's Big Sur's $54 Million 'Catastrophic Landslide' a Result of Drought Followed by Deluge, Scientists Say

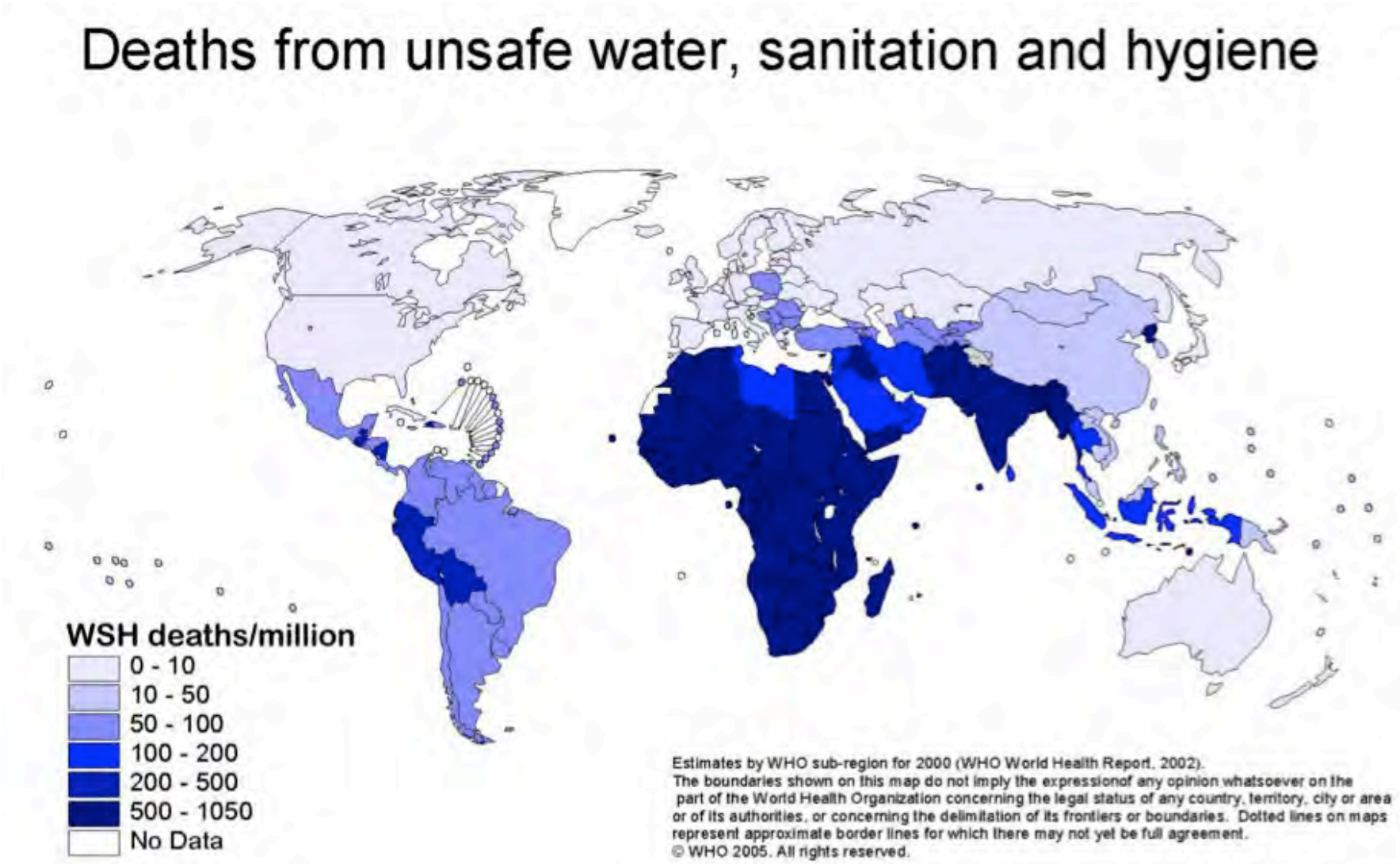
By Pam Wright · 7 days ago · weather.com



Do anthropogenic activities have a significant impact on the changes in weather?

How much is attributed to normal planetary and galactic cycles?

Water Scarcity and Global Impact



Before Resiliency –
Focus was Water Efficiency (Demand Reduction)

Typical Domestic Water Efficiency Measures



1.75 gpm Heads



0.35 / 0.5 Flow Rest



Pint Flush Urina



Waterless Urinals



1.28 gpf Toilets

Demand Reduction

Sinks & Showers





AERATORS



LAMINAR FLOW



- Older conventional faucet flow rates can range from 3.0 to 5.0 gpm.
- For a public lavatory faucet, the Water Sense standard is a maximum of 0.5 gpm
- Most conventional showerheads use 3.0 + gpm at 60 psi water pressure. The Water Sense standard is a maximum of 2.0 gpm.

Have we Reached the Limits in Domestic Water Reduction Strategies?

The Slow Grind to the Tipping Point
(Low Flow Fixtures)

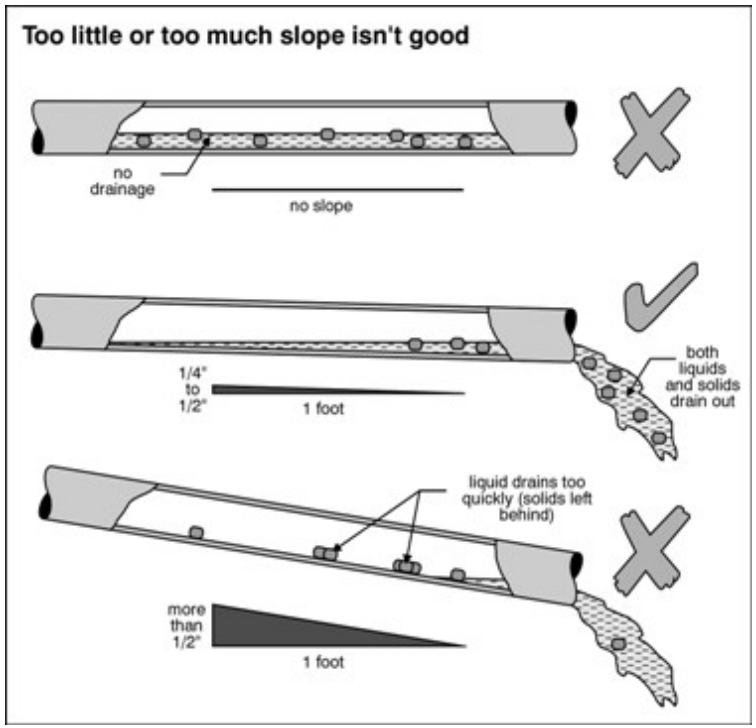
Water Use by Fixture Type (Commercial Office Buildings)					
Fixture Type	**Pre - 1980's**	**1980's**	**1997 (ish)**	**Plumbing Codes (typical)**	**Current Lowest**
Toilet (gpf)	5 +	3.5	1.6	1.28	1.28
Urinal (gpf)	5 +	1.5	1	0.5	0.125 / 0
Kitchen Faucets (gpm)	3.5 +	3.5	2.2	1.8	1.5
Rest Room Faucets (gpm)	3.5 +	2.2	1.0 / 0.5	0.5	0.35
Shower Heads	5 +	3.5	2.5	2.0	0.5

Being too Aggressive with Domestic Water Efficiency can have Unintended Consequences.

Waste Lines were not Designed to Function with Low Flow Devices

- Flush Volume < 1.28 gallon per flush (gpf)
- Incorrect Slope on Horizontal Waste Lines
- Slope Decreases with Building Settling
- Horizontal Run Lengths too Long
- Toilet Tissue Density





Courtesy of Mary Ann Dickinson's Line Carry Studies*

*President and CEO at Alliance for Water Efficiency

Transition to Process Water Efficiency

Groundwater Re-Use / Scrubber Feed Water

Item	Qty (Running)	W/S Rate $/kGal	Combined Avg Flow Rate (gpm)	Total Consumption (gal/.yr)
Harrington Scrubbers	3	$6.70	11	**5,781,600**



Approximately 20 gpm to pit = ~ 10M g/yr.

Fresh Water Aquafer in a University Basement

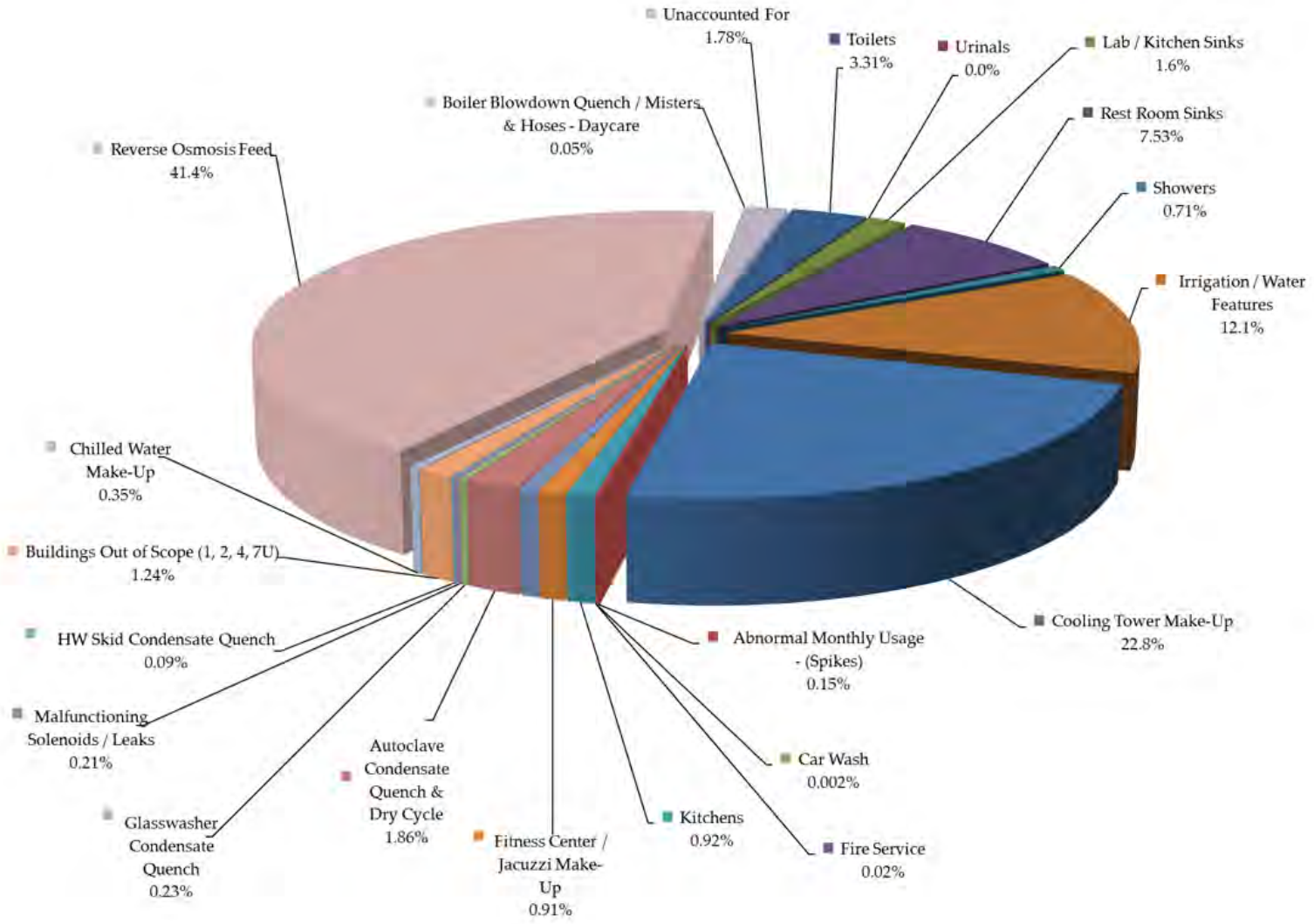


Air Scrubber



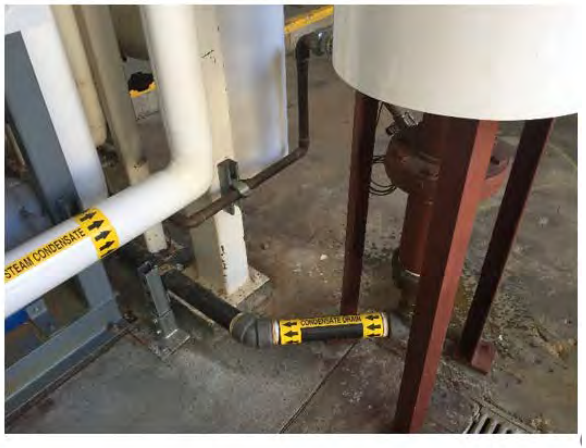
3 hp Pumps with Data Logger
(35 gpm / 16 hrs. /day = 33 kGals / day)

Process Water Efficiency (Water Balance)



Process Water Efficiency (cont.)







1st Floor Janitor's Closet – Failed Solenoid on HEX Quench Line



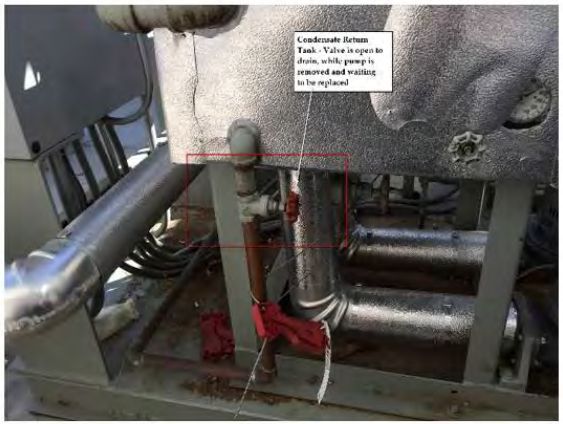
HW Skid – rear of B6, with temperature probe and 'functioning' Solenoid Valve

Process Water Efficiency (cont.)









Utility Yard – Condensate Pump removed and draining to sewer

Condensate Tank Valve – Open to Drain. Pump was removed for over a month.

Process Water Efficiency (cont.)

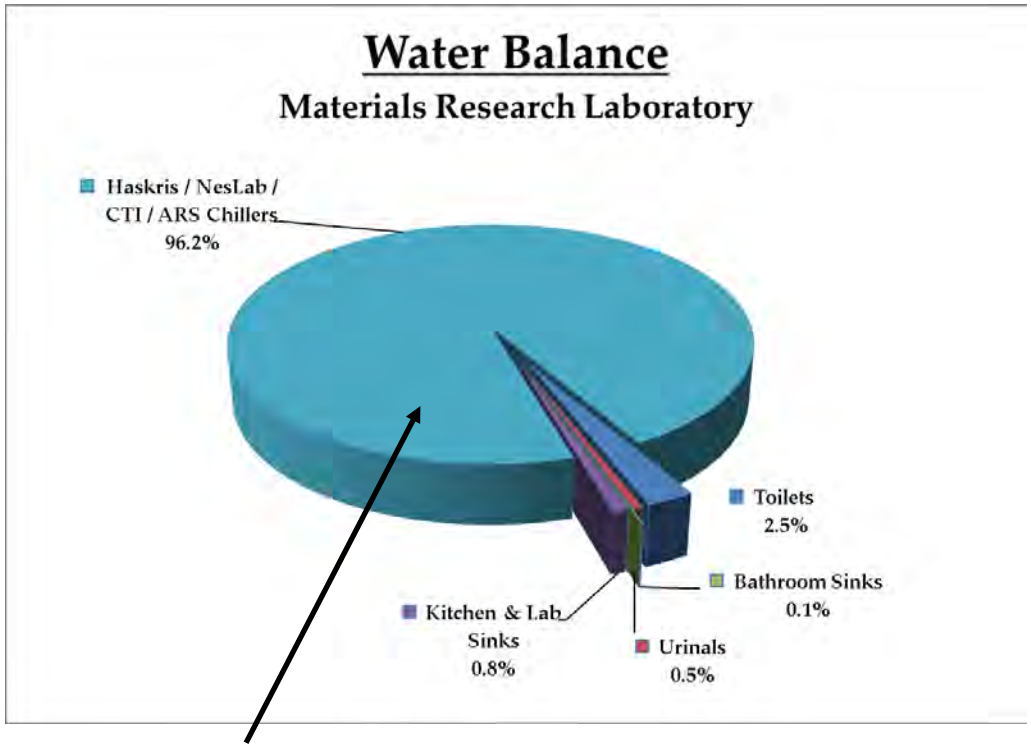




Basement – Strainer valves before steam traps are not holding - .25 gpm of condensate to drain (HX – 1 – 1)

Process Water Efficiency (cont.)

Closed Loop Heat Extraction System



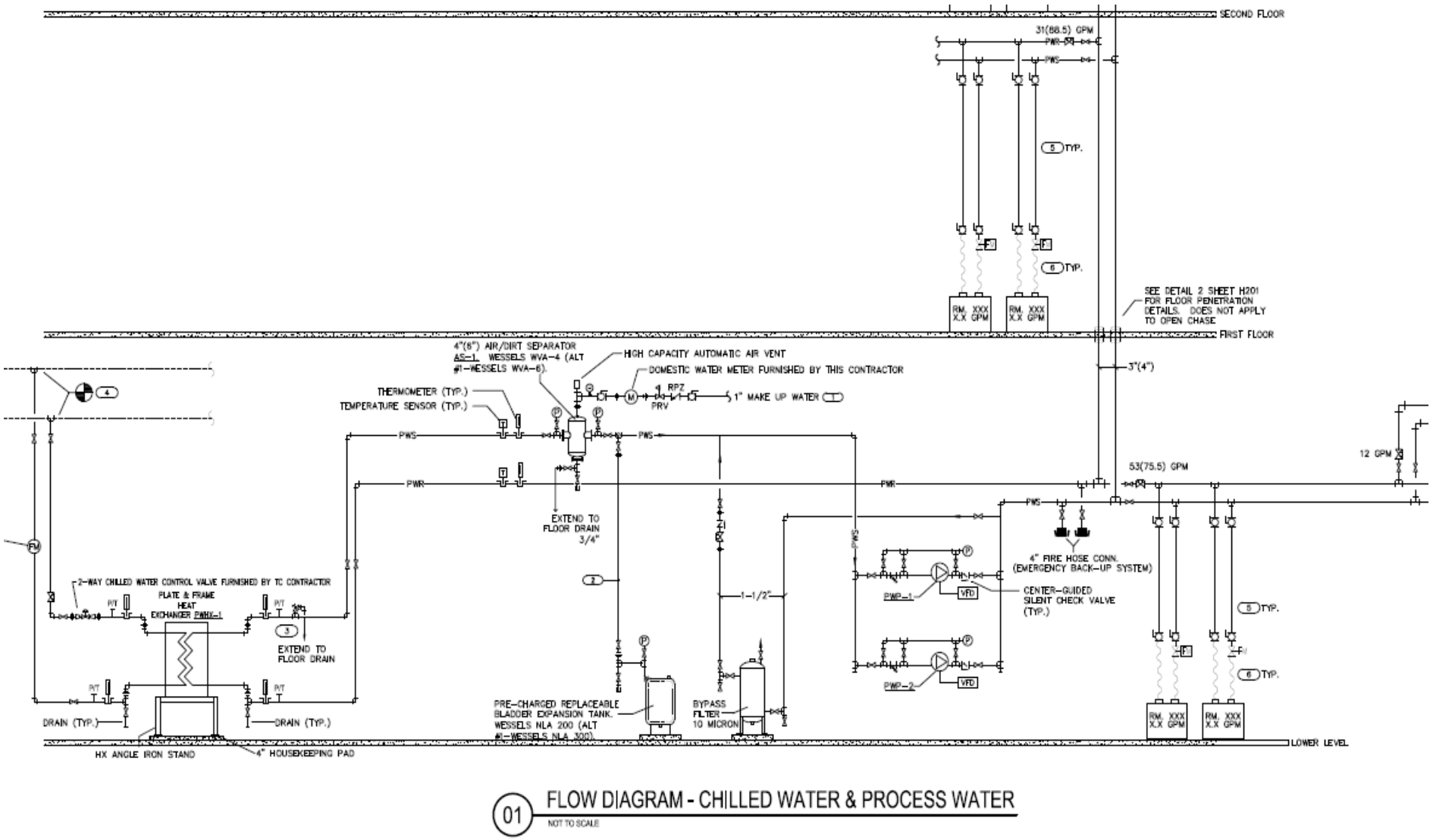
37 Million Gallons / year



Cooling Load ~ 300,000 Btu/hr.



Process Water Efficiency (cont.)



01 FLOW DIAGRAM - CHILLED WATER & PROCESS WATER

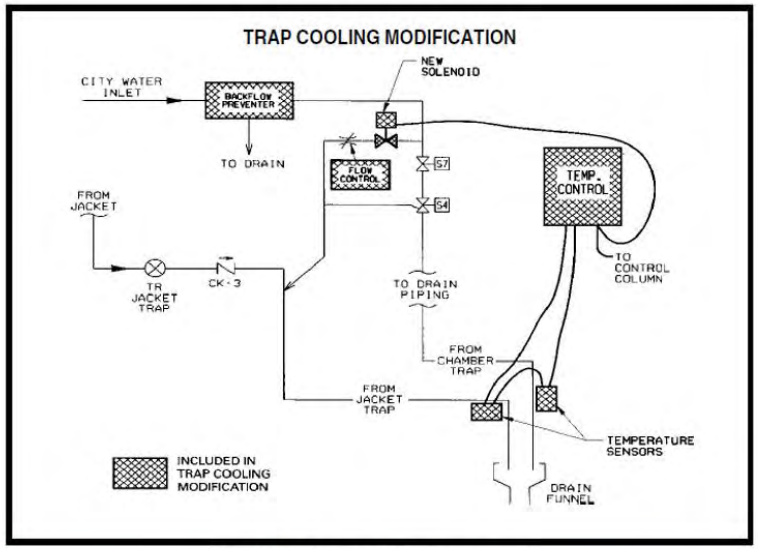
NOT TO SCALE

Process Water Efficiency (cont.)



Hot Water Skid Leaking from the Pump Seals and Housings. Hot condensate with Boiler chemicals is flowing to the Sanitary Sewer

Process Water Efficiency (cont.)



(Typical only - some details may vary.)





Solenoid on Amgen's city water 'quench' line that is failed (partially) open.

Alternate Water Sources - RWH

Collecting, storing, and utilizing rainwater is a sustainable way in helping protect your local water quality from run-off, and reduces overflow to the municipal storm sewer system.

Rainwater can be used for :

- Irrigation for landscapes or gardens.
- Filling pools, ponds, water features, and spas.
- Washing cars, trucks, trailers, boats, etc.
- Make-up water for commercial cooling towers.
- Flushing Toilets



Rainwater Harvesting Assessment I completed for Lockheed Martin's F-35 Plant

Efficiency → Conservation → Resiliency

- Water **Efficiency**: Using improved technologies and practices that deliver equal or better service with less water.

- Water **Conservation**: Similar to Efficiency but actually use less water, typically motivated by a drought or water shortage. You curtail water use by not Watering the grass or washing your car. (Shower every other day?)

- Water **Resiliency?** The ability to avoid, prepare for, minimize, adapt to, and recover from anticipated and unanticipated disruptions in critical services to ensure continuation of Mission Critical tasks, Mission Essential operations and to rapidly reestablish Mission Essential requirements.

It is Reliability and Security combined – **a Backup to a Backup to a Backup.**

Resiliency – Why all the Fuss?

- DOD relies on external sources to function (Commercial Utilities)
- Completely exposes all **Mission Critical** operations and Necessary Services to a partial or complete shut-down, due to external threats.

Critical Facilities:

- Hospitals / Clinics
- Fire Departments
- Housing
- Police Stations
- Communications
- Refrigerated Storage
- Central plants
- Manufacturing/Production
- Fuel storage
- Etc.

Typical Threats



Solar Powered Desalination (Electrodialysis-Photovoltaic Generator)

Brackish or salty water is pumped from a source (sea water, ground water etc.), then water runs through a filter to remove sand, and an activated carbon filter to remove chemicals. Then it is pumped under (high) pressure through a series of **membranes**. The membrane pores are extremely small (usually around 0.0001 micron), and only allows water molecules to pass through.

(No inverters, no batteries, no regulators – portable and low maintenance)





Traditional Desalination System
(Reverse Osmosis)

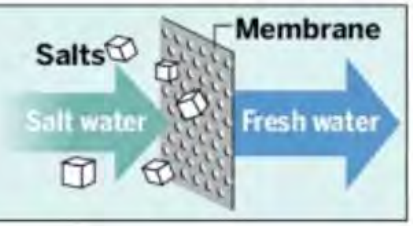


FROM SALT WATER TO TAP WATER

A look at how desalination plants convert seawater or brackish water to drinkable fresh water.

How the filters work

Through a process called **reverse osmosis**, salt water is forced through layers of a superfine membrane to filter out salt and other dissolved contaminants.





1 Intake
Seawater or brackish water is pumped in. Protective screens minimize sucking in sea life and large debris.

2 Pretreatment
Water is filtered for sediments, bacteria and viruses. Solid waste is sent to a landfill.

3 Desalination
Water is pumped through concentric filters. More than 99% of the salt and minerals is removed.

4 Waste
Brine, the remaining water from desalination, is more salty than seawater, so it is mixed with industrial wastewater or seawater to reduce salinity before it's returned to the sea.

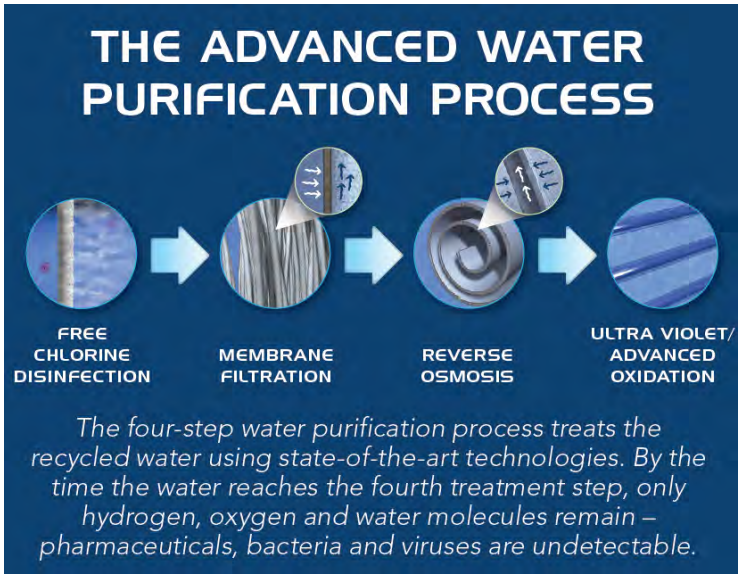
5 Post-treatment
Water is chlorinated. Minerals can be added to match taste of existing water.

6 To the public
Fresh water is stored and released into the municipal water system.

Sources: Bay Area Regional Desalination Project

BAY AREA NEWS GROUP

Advanced Water Purification



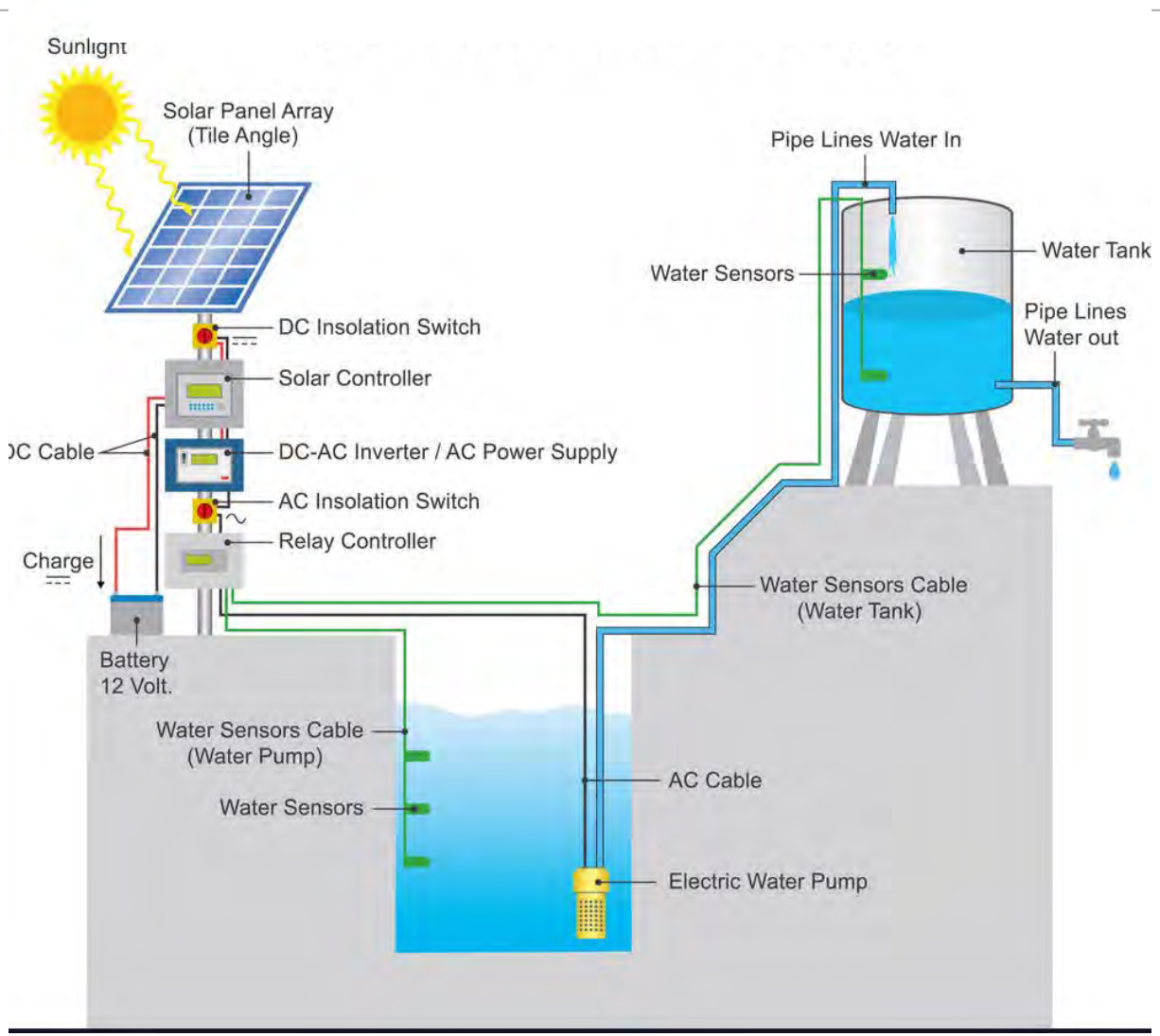


A four-step water purification system that is capable of treating sewage and supplying meets the public health standards for potable water.

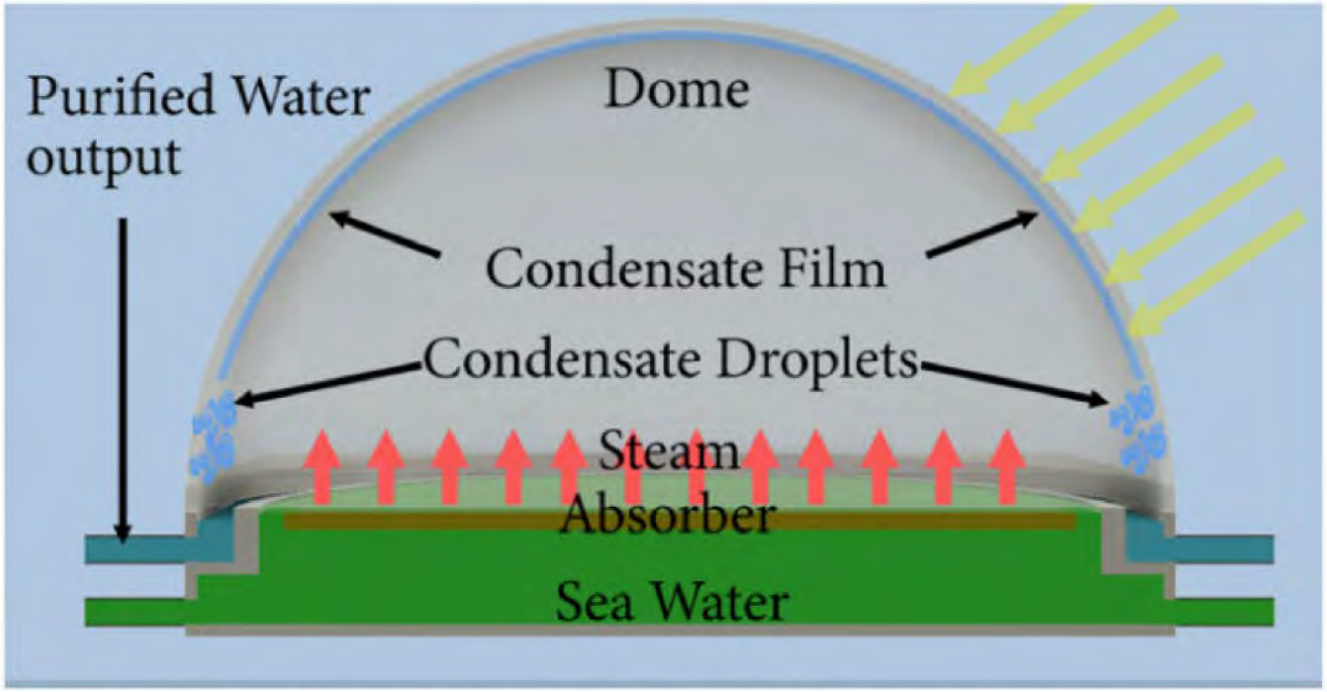
Recently earned approval by the California State Water Resources Control Board's Division of Drinking Water (DDW)

Instead of relying on the City of San Diego to treat and discharge East County's wastewater, this program would treat the water locally and recycle the water using state-of-the-art technology to create a safe, sustainable supply of drinking water.

Solar Powered Water Pump



‘Desalinator’ Prototype, Dubbed the ‘AquaSol’

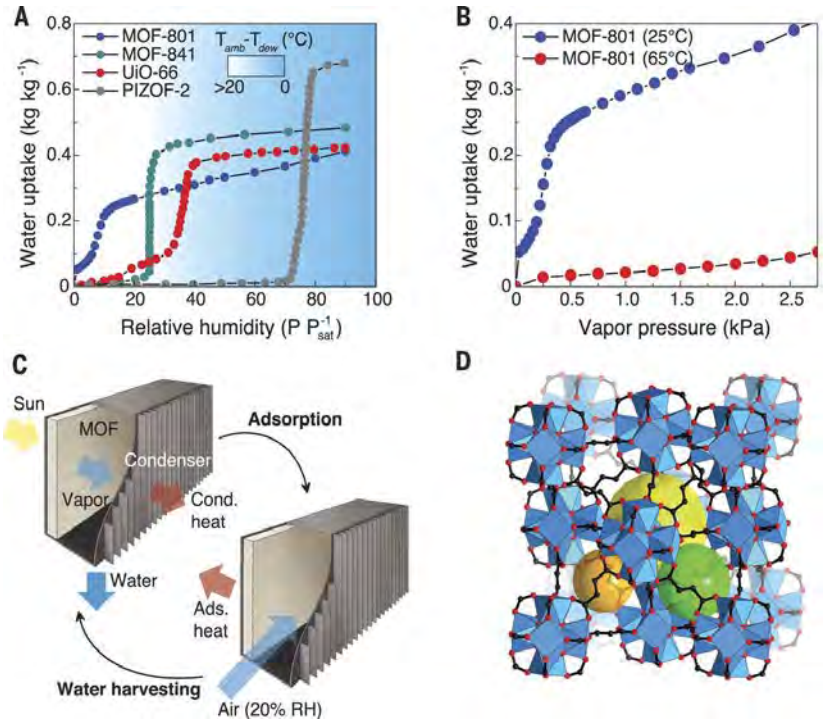


An operational schematic of Aquaneers' AquaSol solar desalinator. The system uses solar energy to produce pure water from sea water.



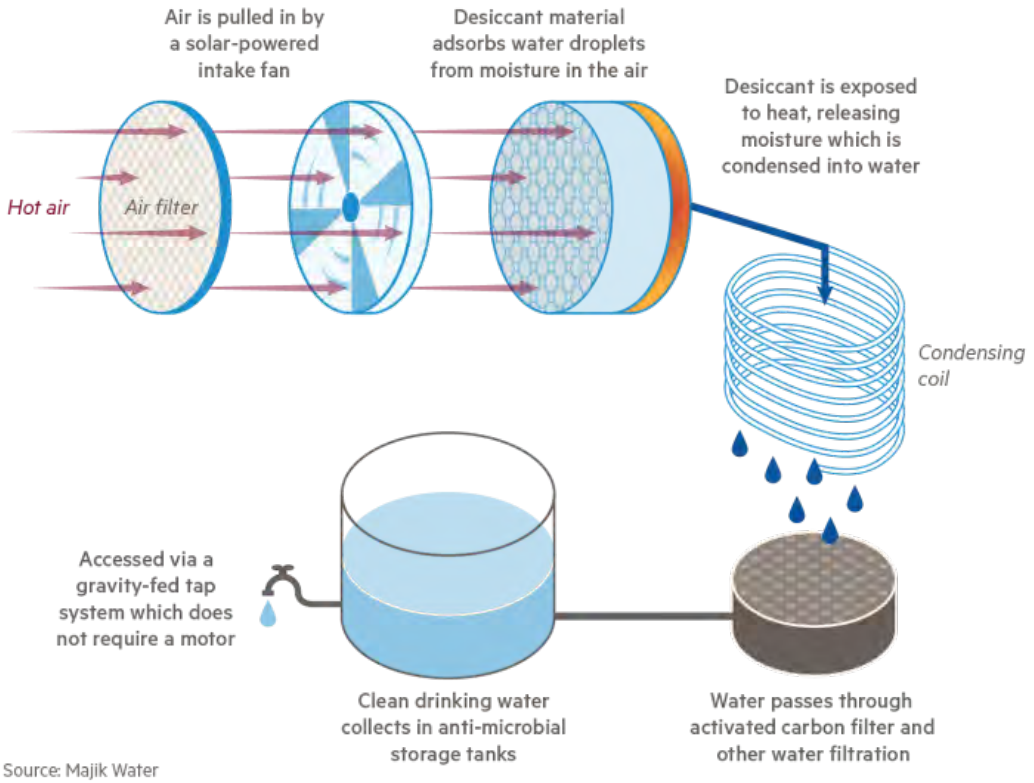


Harvesting Drinking Water from Air



Harvesting drinking water from air

Majik Water's system for extracting water from the air in arid places



Source: Majik Water
© FT

Harvesting Drinking Water from Air (cont.)

Water Production: 2800 Gallons per day



Air to water generators condense outside air & collect the water in a UV-protected continuously ozonated holding tank.

Water drawn from the holding tank is filtered through a series membranes followed by UV light exposure.

Mobile / Temporary Solutions



The Reclaimer Rig

Self-Contained Mobile Domestic Wastewater Processing Solution for sewer management needs



The Water Rig

Self-Contained Mobile Water Solution for Potable Water needs, including:

- Temporary Housing sites
- Construction Site Work Force Areas
- Remote Work/Office Locations
- Emergency Response Locations

Considerations related to Implementing Water Resiliency Measures

** Must include ALL stakeholders related to ancillary support requirements, from Day 1 (concept stage) through implementation and operation **

- Will increase the Energy demand profile
- May require communications with the BAS, introducing cyberthreat concerns and substantial hurdles with IT and communication security.
- Adherence to State and Local drinking water standards, and continuous testing due to potential source water contamination
- Need contingency plans for potential ground water depletion.
- Requires a dedicated team, continuous training and the potential for an on-site lab for water quality testing.