

A nighttime photograph of the Palo Verde Nuclear Generating Station. The facility's buildings and containment domes are illuminated with warm yellow lights. In the foreground, several tall, slender water fountains spray water upwards, creating white plumes against the dark blue night sky. A bright, full moon is visible in the upper center of the frame. The entire scene is reflected in the calm water in the foreground.

Palo Verde Nuclear Generating Station Water Reclamation Facility

Water in the Desert

Because of its desert location, Palo Verde is the only Nuclear Power Facility that uses 100% reclaimed water for cooling.

Unlike other Nuclear Plants, Palo Verde maintains 'Zero Discharge', with no water being discharged to rivers, streams, or oceans.

Water Reclamation Facility (WRF)

An aerial photograph of the Palo Verde Water Reclamation Facility (WRF). The facility is a large industrial complex situated in an arid, desert-like environment. It features numerous large, circular clarifiers arranged in rows, several rectangular industrial buildings, and a network of pipes and walkways. The surrounding landscape is dry and sparsely vegetated.

💧 The Palo Verde Water Reclamation Facility (WRF), is a 90 MGD Tertiary Treatment Plant that reclaims treated secondary effluent from the cities of Phoenix (Scottsdale, Tempe, Mesa, Glendale) and Tolleson.

Conveyance System

28.5 miles gravity flow with 100 feet elevation drop
8 miles pumped flow with 150 feet elevation increase



PVNGS
WRF



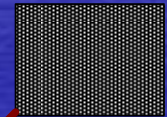
8 miles 66"
pressure
flow pipeline

Hassayampa
Pumping
Station



22.5 miles 96"
gravity flow
pipeline

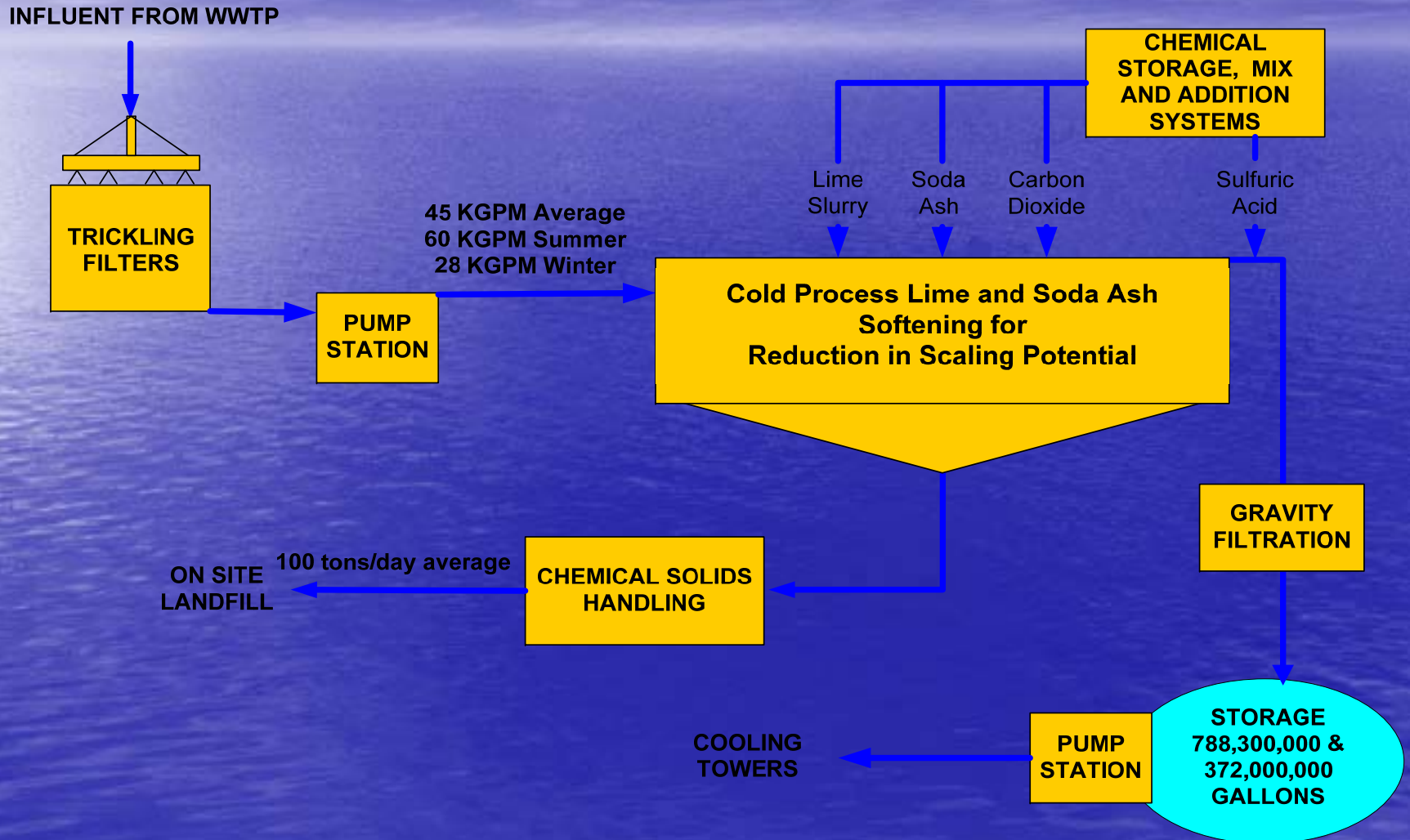
Metropolitan
Phoenix
WWTPs



6 miles 114"
gravity flow
pipeline for
diurnal
storage

Processing WWTP Effluent

Cooling Water Treatment Systems



Cooling Water Treatment

- Softening of wastewater treatment plant (WWTP) effluent is a necessity. Softening is performed to:
 - Minimize scaling potential
 - Maximize water use
 - Minimize quantity of water required

Scale Forming Constituents (ppm)	Influent Quality	Effluent Quality
Alkalinity (as CaCO_3)	189	27
Calcium (as CaCO_3)	183	73
Magnesium (as CaCO_3)	123	15
Silica	19	3.5
Phosphate	10	< 0.1

Water Use

- Approximate cooling water use per MWH generated – 800 gallons
- Cooling water use per year – 77,000 acre feet, 25 billion gallons.
- Cooling Water cycles ≥ 25 , TDS PPM 25,000 – 29,000.



Evaporation Ponds

- Cooling water “waste” from blowdown to evaporation ponds per year ~ 3,000 acre feet, 1 billion gallons



Considerations

- **Source Water**
 - Size of WWTP
 - Diurnal Flows
 - Effluent Chemistry
- **Pipeline**
 - Storage Capacity
 - Right of Way
 - Materials of Construction
- Monitoring/Maintenance Program
 - Surge Protection

Considerations

- **Treatment Plant**
 - Type of Treatment
 - Capacity Margin
 - Effluent Requirements
- Solids Handling Equipment/Landfill
 - Chemical Storage Capacity
 - Materials of Construction

Considerations



- **Reservoirs**

Storage Capacity (Accommodate Plant Outages)

Design/Permitting

Pumping and Transport to Canals

Redundancy for Piping

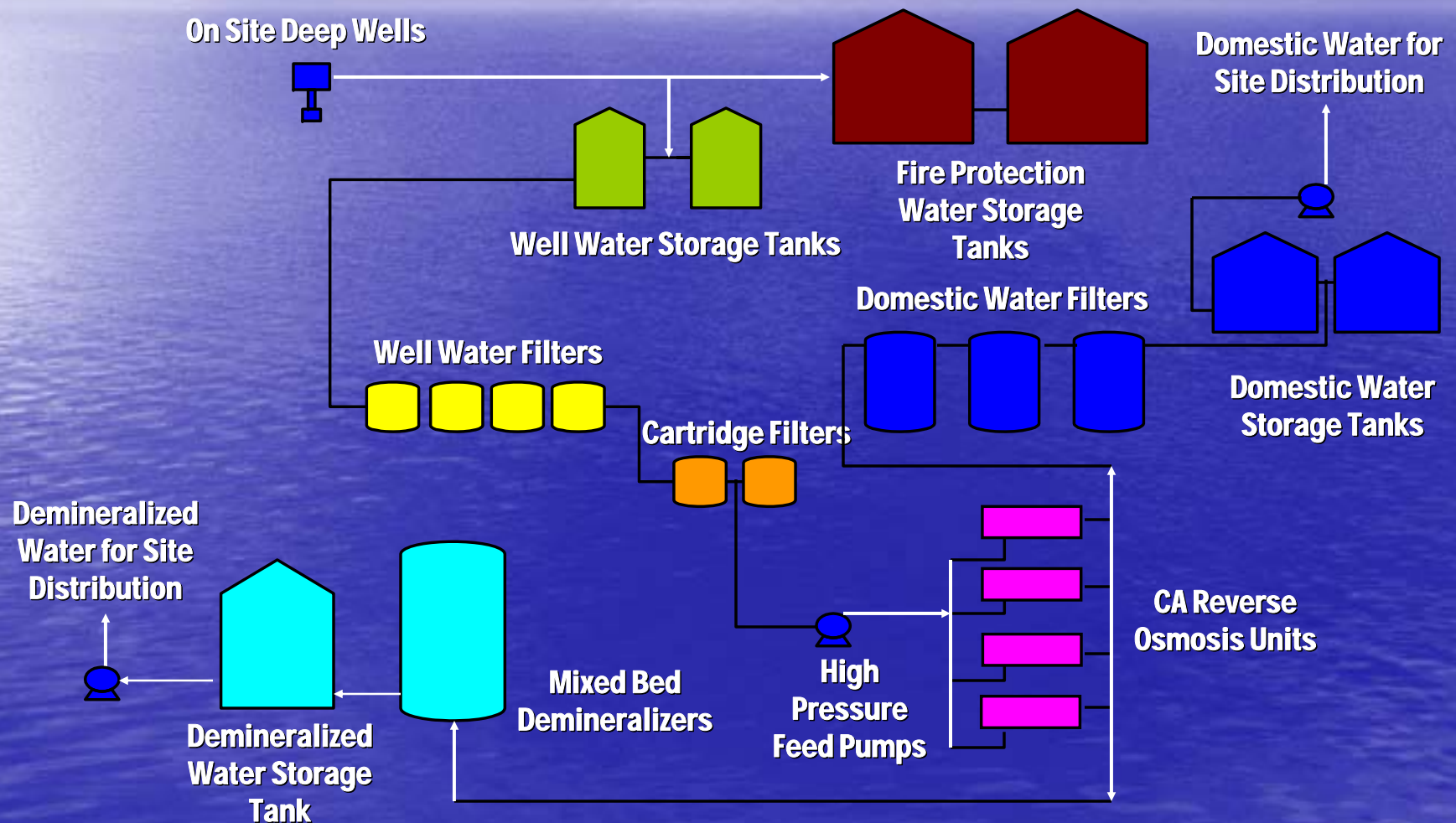
Considerations

- **Disposal**
 - **Blowdown Rates**
 - **Evaporation Rates**
 - **Design/Permitting**
 - **Redundancy**
- **Environmental**
 - **Water Quality**
 - **Air Quality**
 - **Dam Safety**

Ancillary WRF Systems

- **Domestic Water –**
 - **Reverse osmosis units fed from on site wells to provide all potable water needs.**
- **Demineralized Water –**
 - **Mixed bed demineralizer utilized to meet high purity water requirements for the site.**
- **Sodium Hypochlorite Generation –**
 - **Electrolytic cells used to produce bleach from brine.**

Domestic & Demineralized Water Production



Domestic Water

- Reverse Osmosis units with cellulose acetate membranes are utilized to produce potable water from well water.
- The RO product water is stabilized by filtering through calcium carbonate beds prior to storage for site distribution.
- Sodium hypochlorite is also added for sanitation prior to distribution.



Demineralized Water



- **R0 product water is the source stream for demineralized water production.**
- **Product from the mixed bed demineralizers is stored and distributed to the site.**

Sodium Hypochlorite



- The Hypochlorite Generator uses electrolysis to produce chlorine gas and sodium hydroxide from a saturated salt solution.
- The chlorine gas is diffused through the sodium hydroxide to form a stable sodium hypochlorite solution.

