Direct Potable Use of Intruded Seawater from West Coast Basin Aquifers, Los Angeles County, California

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ABSTRACT

Seawater intrusion has been a known occurrence in West Coast Basin aquifers of southwestern Los Angeles County since the 1930s. Historically, the Basin’s confined aquifers had enough pressure to maintain an outflow of freshwater to the ocean. However, overpumping of groundwater from the Basin during the first half of the century decreased groundwater levels to below sea level, causing seawater intrusion into the freshwater aquifers. In the 1950s, the West Coast Basin was adjudicated to prevent further overdrafting. This limited extractions from the Basin to 64,468 acre-feet per year. Additionally, to protect the coastal aquifers from further seawater intrusion, 153 injection wells were constructed between 1953 and 1992 along a 9-1/2 mile (15.3 km) stretch from the Los Angeles Airport to the Palos Verdes Hills. In water year 1998/99, 17,098 acre-feet (2.31 x 10^7 m^3) of potable and highly treated recycled water were injected into the barriers to maintain protection against seawater intrusion.

The barrier injection wells have greatly reduced the amount of seawater intrusion that occurs into the West Coast Basin aquifers, and has protected future groundwater supplies in the region. However, the wells were installed near the coast and not at the leading edge of the intruded seawater, which bifurcated the intrusion and left approximately 250,000 acre-feet (3.1 x 10^8 m^3) of contaminated water (saline plume) remaining to threaten water supplies. This previously potable water which has been impacted by the high chloride plume (concentrations greater than the secondary drinking water standard of 250 mg/L) is unsuitable for municipal and industrial uses. This condition severely limits use of the Basin that currently provides approximately 20 percent of the total demand in the area. Additionally, the Basin provides regional benefit as a water supply during droughts, peak demand periods, and emergencies.

The Water Replenishment District of Southern California is constructing a project to help contain the saline plume from further inland migration. A groundwater extraction well near the leading edge of the saline plume will remove approximately 3,045 acre-feet (3.8 x 10^6 m^3) per year of intruded seawater, thus providing localized containment. The intruded seawater will be run through a desalination facility currently under construction so that it meets all drinking water standards. The treatment process will generally consist of a Reverse Osmosis (RO) membrane system and will include chemical preconditioning and cartridge filtration prior to the membrane process. Following the membrane process and blending with untreated groundwater, chemical stabilization and disinfection are required to deliver a final product water suitable for domestic delivery.
Pretreatment

Chemical preconditioning includes the addition of sulfuric acid and threshold inhibitor, an anti-scalant compound to control the scaling of membranes by soluble compounds that are present in the feed water.

Cartridge Filters

In addition to the chemical preconditioning, RO feed water will be passed through cartridge filters to remove colloidal particles and other impurities that are present in the feed water to prevent damage and clogging of membranes.

Membrane Process and Cleaning

The membrane process will consist of the process inlet pumps, membrane elements, membrane pressure vessels and associated piping and valving. A membrane cleaning solution (detergent) is also circulated through the RO elements two times per year.

Blend Water

A portion of the well water will bypass the pretreatment, cartridge filters and RO membrane process. Following the membrane process, the treated water will be blended with the untreated well bypass water.

Chemical Stabilization and Disinfection

Following blending with the untreated groundwater chemical stabilization (pH adjustment) with sodium hydroxide and disinfection using sodium hypochlorite (bleach) are required to deliver a final product water suitable for domestic delivery.

System Operation

It is expected that the RO system recovery rate will be approximately 85 percent, with average operating pressures of approximately 200 pounds per square inch gauge. Expecting a 90 percent on-line factor, the RO system will have a net production period of approximately 330 days per year. The ten-percent downtime will be required for membrane cleaning and other maintenance.

The water will then be served for direct potable use to the overlying consumers in the basin. The project is expandable to contain and remediate other portions of the saline plume. The project is scheduled to go on-line in summer 2001 after nearly a decade of studies, modeling, and pilot testing.

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