

# Seawater Desalination

## The Claude "Bud" Lewis Desalination Plant and Related Facilities



**DIVERSIFICATION**  
Enhancing Water  
Supply Reliability



**Improving  
INFRASTRUCTURE**

The San Diego County Water Authority and Poseidon Water dedicated the Claude "Bud" Lewis Carlsbad Desalination Plant on Dec. 14, 2015, joined by more than 500 dignitaries and supporters from across California.

The plant is producing up to 54 million gallons per day of locally controlled water for San Diego County, helping to minimize the region's vulnerability to statewide drought conditions. It is part of a \$1 billion project that includes the nation's largest and most technologically advanced and energy-efficient seawater desalination plant, a 10-mile large-diameter pipeline and improvements to Water Authority facilities for distributing desalinated seawater throughout San Diego County.

The plant meets approximately 10 percent of the region's water demand – about one third of all the water generated in the county. This new water supply and its cost are being combined with the Water Authority's other supplies serving 24 local water agencies, 3.3 million people and a \$220 billion economy.

The plant delivers several environmental benefits by using cutting-edge technology to recapture energy from the desalination process, offsetting carbon emissions and developing extensive wetlands that will enhance fish populations along the San Diego County coastline. The entire project was developed through a rigorous environmental permitting process, and the project's environmental compliance was upheld through 14 legal challenges.

Poseidon Water, a private, investor-owned company, developed the project. A joint venture of Kiewit Infrastructure West and J.F. Shea Construction, Inc. designed

and constructed the desalination plant and pipeline. IDE Technologies, a world leader in desalination technology and operations, engineered



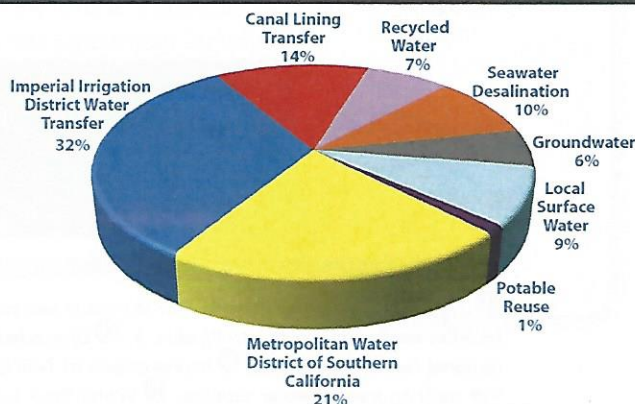
*The Claude "Bud" Lewis Carlsbad Desalination Plant started commercial operation in December 2015.*

the plant's desalination process and related equipment. IDE also operates the plant under contract with Poseidon.

### Project Background

For more than two decades, the Water Authority has viewed seawater desalination as an important part of a diversified water supply portfolio that also includes potable reuse, recycled water, groundwater, independent transfers

### Water Supply Diversification in 2020





## AF = acre-foot

One acre-foot is approximately 325,900 gallons, enough to supply two single-family households of four for a year.

of conserved water from the Colorado River, and water imported by the Metropolitan Water District of Southern California.

In development since 1998, the plant was incorporated into the Water Authority's 2003 Water Facilities Master Plan and the agency's Urban Water Management Plan updates in 2005 and 2010. In the 2015 UWMP, the plant is included as an existing water supply for the Water Authority.

Also in 2010, the Water Authority entered into formal negotiations with Poseidon. Over the next two years, the parties developed commercial and financial terms for the purchase of desalinated ocean water produced at the Carlsbad plant and delivered to the Water Authority's regional aqueduct system. A public opinion survey in 2012 showed strong regional support for desalination, with 82 percent of respondents saying it is impor-

tant for the reliability of the water supply.

## The Water Purchase Agreement

The Water Authority's goal during the negotiations was to assign appropriate risks to Poseidon while keeping costs for water rate-payers as low as possible. After more than 40 public meetings about the project, the Board of Directors on Nov. 29, 2012, voted to approve a contract with Poseidon for the purchase of between 48,000 acre-feet and 56,000 acre-feet of desalinated seawater per year for 30 years. That's enough water for approximately 400,000 people each year.

The purchase agreement transferred to Poseidon and its investors the risks associated with design, construction and operation of the desalination plant. It also transferred risks associated with the design and construction of the pipeline to deliver the desalinated water from the plant to the Water Authority's Second Aqueduct in San Marcos.

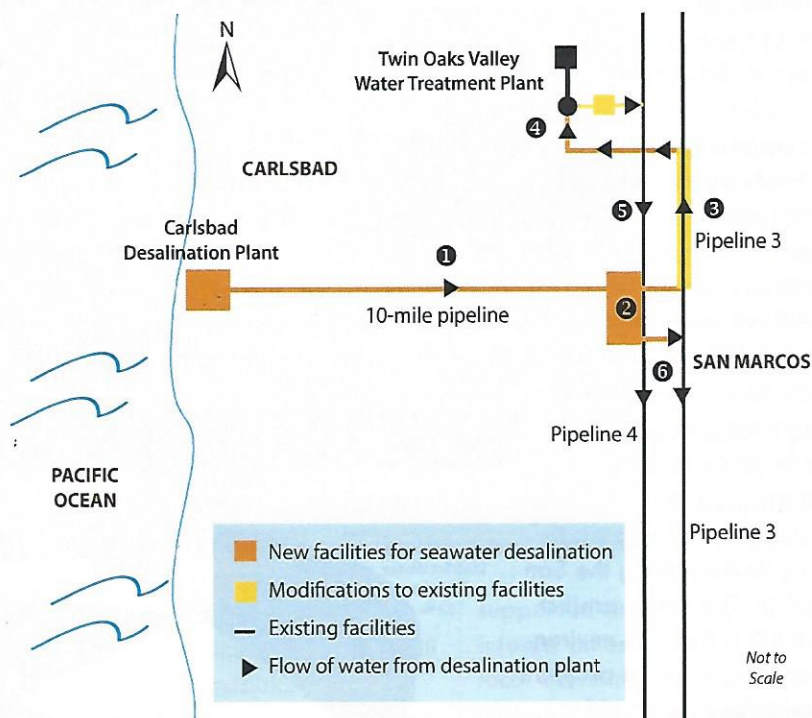
The Water Authority has the option, but not the obligation, to buy the project starting in 2026. In 2046, the Water Authority has the right, but not the obligation, to purchase the desalination plant for \$1. That would provide for public ownership of the plant, intake and discharge facilities, and rights to the long-term lease with NRG, which owns the plant site.

## Financing Terms

After the Water Purchase Agreement was signed, the Water Authority teamed with Poseidon to secure financing for the desalination plant and pipeline via tax-exempt construction bonds. Financing closed in December 2012 at a favorable interest rate, bringing financing costs \$200 million below the Water Authority's projections.

The Carlsbad Desalination Project was honored as the "North American Water Deal of the Year" for 2012 by Project Finance, an international trade publication that annually highlights major industry accomplishments around the world. The magazine said the \$734 million bond issue "could serve as a useful template" for public-private partnerships in the water industry, particularly for seawater desalination projects.

## Adding Seawater Desalination to Water Authority System



- ① Desalinated seawater flows to San Marcos in new pipeline. ② New pipeline control facilities send water north into Pipeline 3. ③ Upgraded Pipeline 3 delivers water to regional hub at Twin Oaks. ④ Improvements at Twin Oaks plant blend desalinated water with existing treated water supplies. ⑤ Water flows south in Pipeline 4 to control facility ② and then continues southward into Pipelines 3 and 4. ⑥



### Water Purchase Price

Based on current electricity cost estimates, the Water Purchase Agreement sets the price of water at \$2,125 to \$2,439 per acre-foot in fiscal year 2018, depending on how much is purchased. The first 48,000 acre-feet of water purchased each year will pay for the fixed costs of the project and the variable costs of water production. The Water Authority has the option to purchase an additional 8,000 acre-feet per year at a lower rate that reflects only the variable costs of incremental water production.

Typical monthly costs are about \$5 per household, at the low end of the Water Authority's 2012 forecast.

The Water Purchase Agreement allows for annual price increases for inflation estimated to average 2.5 percent per year. This compares favorably to the average 8 percent increase per year in imported treated water rates imposed by the Metropolitan Water District of Southern California from 2008 through 2018. In addition, Poseidon will be allowed to increase its price to accommodate changes in law or regulations that generally apply industry-wide to water treatment facilities or wastewater dischargers. These cumulative increases are capped at 30 percent over the 30-year term of the agreement.

### The Plant and Desalination Process

The desalination plant sits on about six acres of public utility zoned land next to NRG's Encina Power Station on Agua Hedionda Lagoon in Carlsbad. It cost an estimated \$537 million.

The heart of the desalination plant is a reverse-osmosis system designed by IDE Technologies. Ocean water is pumped to the desalination plant, where it undergoes a sand/anthracite filtration process to remove suspended particles from the water. Then, the water is pumped through reverse-osmosis membranes that remove salts and other dissolved particles. Essential minerals are added back into the water before it is piped to the Water Authority's aqueduct as

drinking water.



*Reverse osmosis vessels are a key part of the desalination process.*

It is expected that by 2019 the Encina Power Station will be shut down, slated to be replaced by a more modern power plant set back from the coastline. Because the existing plant will stop power production and cease using seawater for cooling, Poseidon is preparing to reconfigure the desalination plant's seawater intake and upgrade the intake to comply with new environmental regulations. Poseidon also will take over responsibility for dredging the lagoon.

The preliminary estimate of the capital costs for intake-related upgrades is \$38 million (2016 dollars) and the operating costs are projected to increase by \$3.6 million per year. The intake-related upgrades were anticipated in the Water Purchase Agreement. In fact, the agreement includes specific cost caps that limit the Water Authority's cost responsibility. Once in operation, the new intake modifications are expected to increase the Water Authority's cost for water purchased from the plant by about 6.5 percent.

The Claude "Bud" Lewis Carlsbad Desalination Plant was honored with a Global Water Award as the Desalination Plant of the Year for 2016 by Global Water Intelligence, publisher of periodicals for the international water industry. The award was given to "the desalination plant, commissioned during 2015, that represents the most impressive technical or ecologically sustainable achievement in the industry."



### The Pipeline

A 10-mile pipeline delivers water from the desalination plant to the Water Authority's Second Aqueduct. The Water Authority owns the pipeline, which cost an estimated \$159 million.

Pipeline installation began in spring 2013 in San Marcos, then expanded to include work in the neighboring city of Vista and in Carlsbad, home to the largest portion of the pipeline.

The Second Aqueduct conveys desalinated water to the Water Authority's Twin Oaks Valley Water Treatment Plant north of San Marcos, where it is mixed with existing drinking water supplies for regional distribution.

### Water Authority Improvements

To integrate desalinated water into the regional water delivery system, the Water Authority made several upgrades to its existing conveyance system and the Twin Oaks plant. A five-mile section of Pipeline 3 (part of the Second Aqueduct) was relined



to accommodate increased water pressures created by pumping desalinated water uphill to the treatment plant. In addition, the Twin Oaks plant was modified so that desalinated water can be stored along with imported drinking water supplies.

These upgrades to the Water Authority's system cost about \$80 million.

### Environmental Enhancements

The Carlsbad Desalination Project meets rigorous environmental standards set by state and local agencies, including the California Coastal Commission. By boosting the project's energy efficiency, offsetting greenhouse gas emissions and enhancing coastal habitat, the project is among the most environmentally friendly projects of its kind in the world.

Poseidon's Climate Action Plan calls for the plant to be net carbon neutral over 30 years by offsetting greenhouse gas emissions from project operations. It is the first major California infrastructure project to eliminate its carbon footprint. This will be done through the purchase of carbon offsets and energy recovery technology at the desalination plant. Energy recovery devices will save an estimated 116 million kilowatt-hours of energy per year, reducing CO<sub>2</sub> emissions by 42,000 metric tons annually – roughly equivalent to the annual greenhouse gas emissions from 9,000 passenger vehicles.

Poseidon also is restoring 66 acres of wetlands in San Diego Bay. The project involves excavating and grading a former salt production pond to create a mosaic of coastal habitats beneficial for a variety of fish and bird species. In addition, Poseidon is preserving the 400-acre Agua Hedionda Lagoon by assuming responsibility for the continued stewardship of the lagoon and restoration of 37 acres of wetland habitat.

### Economic Benefits

During construction, the Carlsbad Desalination Project

supported an estimated 2,500 jobs and infused an estimated \$350 million into the local economy. The plant supports approximately 36 full-time employees and 124 indirect jobs now that it is operational. Poseidon also anticipates \$45 million in direct annual spending related to plant operations throughout the region. ■



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