

**DESCRIPTION/SUMMARY OF ACTIVITIES CONCERNING UPPER OSO
RESERVOIR FOR PERIOD OF TIME COMMENCING OCTOBER 28, 2009
THROUGH NOVEMBER 13, 2009**

On October 28th, 2009, cold weather and high winds triggered a change in the stratification of Santa Margarita Water District's Upper Oso Reservoir resulting in the conversion of sulfates to sulfides throughout the reservoir. The following summarizes activities from October 28th through November 13th that have been taken to restore the condition of the Reservoir:

- **Thursday, October 29th, 2009:** Twice daily sampling of temperature and dissolved oxygen levels were commenced. A meeting was held with Solar Bee¹ on-site. Solar Bee recommended continued operation of its aeration pumps and recommended against activating the mechanical air compressor that was used prior to the operation of the solar-powered pumps. Water leaving the reservoir for irrigation was treated with hydrogen peroxide to eliminate sulfides.
- **Friday, October 30th, 2009:** Temperature and dissolved oxygen (DO) testing indicated the Reservoir water was uniformly mixed. The mechanical aeration system was turned on. The mechanical aeration compressor is rated at 480 cubic feet per minute and the discharge is polyethylene tubing with 1/16-inch holes every three inches. PACE, a consulting engineering firm that specializes in reservoir/lake management, met with District staff to review the situation and make remedial recommendations. PACE confirmed it was appropriate to activate the mechanical aeration.
- **Saturday October 31, 2009:** DO and Hydrogen sulfide levels were monitored in the Reservoir. Additionally, 650 gallons per minute (gpm) of potable water was added at the northern Reservoir inlet. The District commenced daily use of handheld RKI Instruments gas detectors around the Reservoir and in the adjacent neighborhoods (minimum read level is 500 ppb).
- **Sunday November 1, 2009:** DO levels were monitored.
- **Monday November 2, 2009:** PACE commenced efforts to obtain a portable ozonation unit to supplement air-flow into the Reservoir complemented by the combination of aeration and introduction of oxygenated water from potable and recycled water. Further, potable water discharge into the Reservoir was increased to 2300 gpm. Two boats were operated throughout the Reservoir, generating wave action to break up the surface of the Reservoir enhancing air transfer. Additionally, a 450 gpm portable pump was installed to spray water and increase aeration. Daily discussions were held analyzing a variety of chemical addition options. The Solar Bee inlets were raised from 11 feet deep to six feet deep to treat the surface.

¹ The District purchased and installed four solar powered aeration pumps manufactured by Solar Bee within the Reservoir replacing an electric compressor with a coarse bubble air line for mixing. Solar Bee has provided direction since installation on the operation of the devices and management of the Reservoir.

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- **Tuesday November 3, 2009:** A larger 600 gpm pump and a compressor with fine bubble diffusers were installed; the diffusers are rated for 96 standard cubic feet per minute (SCFM). All other activities continued.
- **Wednesday, November 4, 2009:** Rental of an Ozone unit was authorized²; the amount of hydrogen peroxide used in the distribution system was increased. All other activities continued.
- **Thursday November 5, 2009:** Delivery and installation of electrical power for the ozone and temporary aeration pumps was coordinated. An additional 5,000 gpm of recycled water was arranged from the Irvine Ranch Water District Los Alisos Plant. All other activities continued.
- **Friday November 6, 2009:** Two 20 horsepower surface aeration units were installed. Each unit is capable of adding 900 lbs of oxygen per day with a 230 foot diameter zone of dispersion. The ozone unit was delivered and installation commenced. All other activities continued.
- **Saturday November 7, 2009:** Ozone generation was commenced at reduced power per the manufacturer's instructions. All other activities continued.
- **Sunday November 8, 2009:** Ozone generation was increased to maximum capacity. The unit generates approximately 50 lbs of oxygen per day. All other activities continued.
- **Monday November 9, 2009:** Monitoring continued along with discussions with a variety of chemical suppliers for the purpose of determining the effectiveness/efficacy. All other activities continued.
- **Tuesday November 10, 2009:** Two additional aeration pumps were installed on the west side of the Reservoir; each unit adds an additional 900 lbs. of oxygen per day. An additional 3,000 gpm pump was added to move water from recovering areas and deliver it to a poorer water quality area to speed recovery. A meeting was held with air quality representatives from AECOM to determine air sampling locations. All other activities continued.
- **Wednesday November 11, 2009:** The purchase of all available stock of granular sodium percarbonate in the Southern California region was authorized to oxidize sulfate and Clean Lakes, Inc. (Clean Lakes) was authorized to disperse the chemical using its specialized boats. Vacuum air sample bottles were set at the Reservoir for 16 hours starting at approximately 5:00 pm. All other activities continued.

² Ozone (O₃), which has an additional available oxygen molecule, nearly instantly interdicts sulfide compared to the substantially longer time for atmospheric oxygen (O₂) to interact with sulfide.

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- **Thursday November 12, 2009:** Reservoir location air sample bottles were collected for testing. Additional samples were set at 5:00 pm. Delivery of 10,200 pounds of sodium percarbonate was taken at the Reservoir. All other activities continued.
- **Friday November 13, 2009:** An additional 6,000 pounds of sodium percarbonate was delivered to the Reservoir and Clean Lakes applied a total of 16,200 pounds in the Reservoir near the dam, which was determined to be the most effective location based on water quality monitoring data. Air sample bottles located at the Reservoir were collected for testing. All other activities continued.

Recovery markers have continually improved as evidenced by increasing DO and Oxygen Reduction Potential levels. Aqueous sulfide levels are decreasing with some areas now showing no detectable sulfides. Water quality sampling will continue on Saturday, November 14th to determine the effectiveness of the chemical addition and other suite of remedial measures.