



Entrainment

Impingement

Thermal Impacts

Outfalls and Discharge Plumes



## ● CLEAN WATER ACT STUDIES AND OUTFALL-RELATED SERVICES

Weston Solutions, Inc. (WESTON®) has conducted numerous studies in support of Clean Water Act (CWA) provisions that focus on thermal effects (316a) and entrainment and impingement (316b) of aquatic organisms in waters used for industrial purposes. These studies tend to be complex and require quantification of organisms that might be affected by entrainment (both primary and secondary entrainment), impingement, and thermal impacts. These projects often include delineation of discharge plumes, water modeling, and engineering studies.

Our related project experience includes 29 years of ocean monitoring for dischargers (thermal, nuclear, and wastewater) such as Orange County Sanitation District (OCSD), City of San Diego Metropolitan Wastewater, Los Angeles County Sanitation Districts, Encina Wastewater Authority, San Elijo Joint Powers Authority, and Encina Power Plant. In addition to the project examples presented below, WESTON's clients for CWA 316 studies also include Public Service Electric and Gas, Columbus and Southern Ohio Electric Company, and Atlantic Electric.

Our expertise in marine biology includes long-term, as-needed contracts with the U.S. Department of the Interior Minerals Management Service for the Pacific Outer Continental Shelf Region and the Pilot (1994), 1998, and 2003 Regional Monitoring Program of the Southern California Bight conducted by the Southern California Coastal Water Research Project (SCCWRP).

### Entrainment/Impingement

We have conducted comprehensive marine environmental studies of coastal and intertidal communities surrounding the San Onofre Nuclear Generating Station (SONGS) for 10 years. The studies focused on impacts associated with thermal and physical effects on marine organisms from entrainment and impingement in cooling water, suspended sediments, and discharge-related turbidity. Extensive sampling occurred offshore and within the power plant. Specific studies included the following:

- Prediction of thermal effects on zooplankton and hypoplankton
- Prediction and measurement of impacts on plankton, benthos, mysids, and sand crabs
- Plankton and dye field studies
- Determination of adult equivalent losses for fish eggs and larvae
- Estimation of the increases in nutrients and phytoplankton production due to entrainment of deeper offshore water

WESTON also conducted impingement monitoring at SONGS to assess the species, size, and biomass of organisms entrained on the intake traveling screens for the cooling systems. Various modifications to the intake structures were tested for reducing impingement impacts including fish diverters, different types of lighting, and different frequencies and intensity of sonar sounds.



*WESTON has conducted numerous CWA support studies on thermal effects (316a) and entrainment and impingement (316b) of aquatic organisms in waters used for industry.*

## Clean Water Act Expansion and Outfall-Related Services



### Thermal Impacts

As part of our long working relationship with the SONGS, we also assessed the impacts of increased thermal discharge temperatures from SONGS Units 2 and 3 on the plankton, ichthyoplankton (fish plankton), and larger nektonic communities. WESTON developed the study design, and conducted field sampling and laboratory analyses in a rapid response mode to facilitate application for an increase in the maximum discharge temperature for SONGS' operating NPDES permit.

WESTON evaluated the effects of entrainment, mechanical stress, and thermal impacts on entrained plankton at the same SONGS units. A series of laboratory studies were conducted to determine the impact of entrainment on plankton survival, motility, and vitality. Plankton samples were collected at different locations within the power plant and studied to determine the proportion that could survive entrainment.



### Outfalls and Discharge Plumes

WESTON conducted an outfall study for the Orange County Sanitation District (OCSD) to assess whether effluent was leaking from the outfall pipe that extended from the beach to about 4 miles offshore. Rhodamine WT dye was injected into the OCSD wastewater outfall pipe and sampling was conducted along the length of the pipe from the beach to the diffuser to evaluate potential leakage. Temperature, salinity, dissolved oxygen, and light attenuation were measured as ancillary signals of effluent leakage. Water samples for dye and bacteria were also collected near the bottom over the outfall pipe, on the beach, and in the effluent plume. Scuba divers with instrument packages measured and sampled the inshore waters while a sampling boat and crew used instrument profiling systems (SeaBird) and plume tracking systems (Minibat) to evaluate the offshore section of the pipeline. In summary, no effluent leakage was detected anywhere along the length of the outfall pipe or the beaches, even after 3 days of plume tracking.

WESTON has also conducted rhodamine dye studies to detect and map water discharge plumes from offshore oil and gas production platforms. Plumes were monitored from four different production platforms having different discharge volumes and multiple discharge locations. Produced water plumes were monitored using a towed instrument array with multiple sensors. The plumes' measurements were compared to EPA discharge plume model predictions and were found to be reasonably close to the actual field measurements for high-volume discharges.

### WESTON Experience Adds Value

WESTON's greatest value to CWA water quality studies comes from its advanced in-house expertise in the biological and chemical sciences, as well as its engineering knowledge of industrial facilities and operations.

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