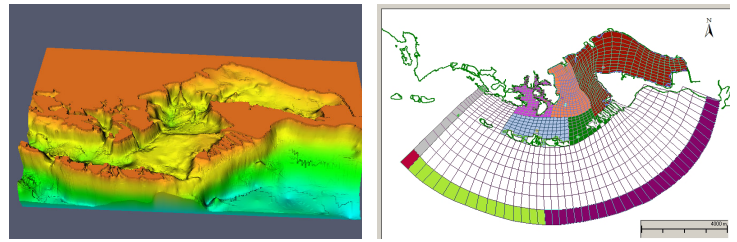


Thermal Plume Discharge and Intake Entrainment Study Aguirre Station

Washington Group and PREPA, Jobos Bay, Puerto Rico



Situation

The purpose of this study was to evaluate the impact of cooling water intakes on the entrainment of aquatic organisms and to estimate the extent and orientation of the thermal plume. The cooling water intake structure is located near the northern shore of Jobos Bay and withdraws 450,000 gpm of water. This water is routed back through a discharge tunnel extending 5800 ft south into the bay. Due to limitations on the size of the thermal plume 316(a) and the required minimal entrainment of the aquatic organisms 316(b), a 3-D hydrodynamic and transport model was applied to demonstrate the existing impacts of the plant operation on the indigenous population.

Approach

A three dimensional hydrothermal model, GEMSS-HDM (Generalized Environmental Modeling System for Surfacewaters-Hydrodynamic Module) coupled with GEMSS-ENM (Entrainment Module), a spreadsheet based model capable of modeling several entrainment regions, was used. HDM generates the flow fields in the region and uses them to estimate heat transport. ENM, on the other hand, uses these flow fields to simulate transport of fish eggs, larvae and juveniles throughout the water body between sampling regions and eventually into the plant intake. After an extensive model calibration to a variety of field measurements, the thermal plume was extrapolated to the full plant generation capacity and high summer temperature conditions for the 316(a) study.

To support the 316(b) variance, the hydraulic zone of influence was calculated using GEMSS® and was further elaborated to include the Boreman-Goodyear ETM

(Empirical Transport Model) and EAM (Equivalent Adult Model) formulations, sub-modules forming GEMSS-ENM. The latter included estimates of equivalent adult fish population impacts based on fish egg and larval density data collected in Jobos Bay for the period between April 2003 and April 2004.

Results

Analysis of the thermal plume showed that the discharge was within the EPA, World Bank and Puerto Rico Water Quality Standards. The 3°C temperature rise plume was about 320 m in length and 100 m wide at the surface and did not reach the bottom. The entrainment study estimated the increase in the species mortality due to the intake structure operation to be as much as 35%. This conditional mortality rate (CMR) was almost zero for a majority of the species sampled but for some species (e.g. Engraulidae) that were in high abundance was predicted to experience the most impact in population due to the plant operations.

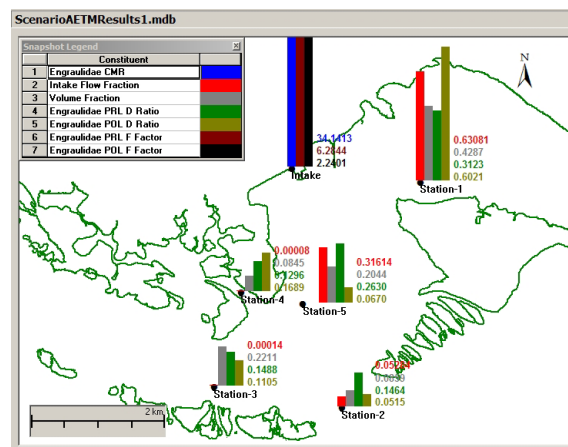


Figure 1 CMR values for Engraulidae species