Submarine Tailings Disposal Studies in Stephens Passage

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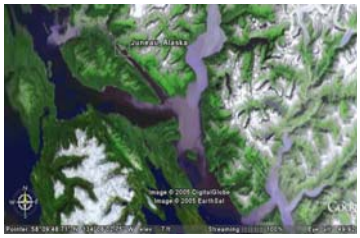

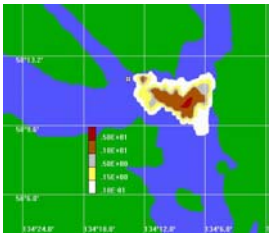

Situation

The purpose of this study was to evaluate the impact of proposed submarine tailings outfall in Stephens Passage. The outfall would discharge solids continuously or intermittently at a depth of 100 m for a period of 13 to 15 years. The only practical way to include the effects of the complex bathymetry and ocean currents on tailings distribution on the ocean bottom was to use a numerical model to simulate the relevant processes.

Approach

ERM's Surfacewater Modeling Group developed and maintains a publically available, three dimensional hydrodynamics in-house model GEMSS® (Generalized Environmental Modeling System for Surfacewaters). The - Hydrodynamic Module HDM was used to compute spatial and temporal variation of ocean currents in the Passage. A three dimensional particle based Lagrangian random walk module (LSTM – Lagrangian Sediment Transport Module) was to used evaluate the distribution of tailings on the ocean bottom based on design parameters for the tailings pipe, and on the model predicted ocean currents. Yearly predictions of tailings foot print areas on the ocean bottom and suspended tailings concentrations in the receiving waters were obtained from the model and were used by biologists to evaluate its impact on benthic and marine organisms. GEMSS® three dimensional visualization software was used to display tailings foot prints on the bathymetric background of Stephens Passage. The model results were also used to set up sediment monitoring program in the Passage.

The near-field mixing zone calculations at the point of tailings discharge were required as part of EPA's NPDES permit regulations. A new three dimensional Lagrangian plume model was developed to predict the near field characteristics of bottom discharges. The dilution and mixing zone dimensions were computed for various mixing fluids, bottom slopes, and receiving water stratification. The model results showed that the mixing zone was limited to 50 to 60 meters downstream of the discharge and to 30 meters from the bottom. None of the cases simulated showed plume rising to the surface.

Results

The results of the simulations indicated that the tailings discharged into the Stephens Passage resulted in a distribution of tailings with heavy particles depositing close to the discharge pipe and light particles spreading all over the Passage. The deposition near the discharge was confined to a narrow region downstream of the discharge pipe whose dimensions gradually increased with time due to the gravity induced turbidity flows and slumping due to slope failure.