Modeling environmental impact caused by spreading of dredged material during dredging and deposition.

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Introduction: The Town of Fredrikstad is located at the outer part of the Oslofjord area. The harbor area is located in the Glomma archipelago, Glomma is the largest river in Norway. The river entrance area is polluted with PAH's, PCB's heavy metals and TBT, essentially transported to the site by the river water masses. The entrance to the harbor area is planned to be dredged, which will involve the transport and deposition of pollutant masses and (unpolluted) dredged material to a local basin nearby. The issue is to dredge, transport and deposit the pollutants (as well as the dredged material) to the basin selected for the deposition of the masses, with minimum spreading of the pollutants as well as the dredged material.

Methods: The method applied is based on modeling the hydrodynamics of the river flow and estuarine circulation in the area, combined with modeling the spreading of the dredged material with a separate model. Output from the hydrodynamic model (water current field and density stratification) is used as input to the modeling of the spreading and deposition of the dredged material. The hydrodynamic model is an Eulerian type model (calculating the current field in a grid), while the model for the spreading of the material is a Lagrangian type of model (that represents the discharge in terms of particles discharged in the model domain). Both models are fully three-dimensional and include time variations as well.

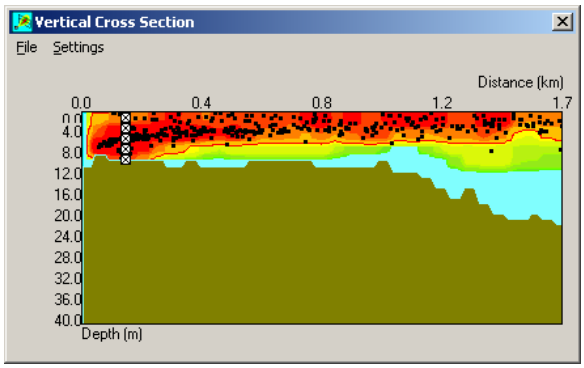

Fig. 1: *Example of spreading of dredged particles downstream during dredging in an estuary. Vertical cross section with the downstream river flow to the right.*

Results: The actual processes planned to take place involves dredging, deposition of polluted masses, establishment of barriers for creating a basin for deposition of the polluted masses and also deposition of the (unpolluted) dredged material on top of the polluted masses. The modeling revealed the most critical part of the operations was the dredging of the polluted masses in the river entrance area. The model also calculated the spreading of the polluted masses during dredging (Fig. 1).

Discussion: The combination of hydrodynamics with models for spreading of contaminants represents a powerful mean to predict the fate of pollutants during operations that involve dredging and depositions. The model calculates the PEC (Predicted Environmental Concentration) of selected pollutants for various operations. Combined with the PNEC (Predicted No Effect Concentration) limit for each pollutant considered, a risk characterization can be established (sometimes denoted as a PEC/PNEC approach) which is an approach recommended by EU (TGD, 2003). The model system applied includes such capabilities as well, although this capability was not utilized in the present project.

References: EU-TGD (2003): Technical Guidance Document on risk assessment in support of Commission Directive 93/67/EEC on risk assessment for new notified substances and Commission Regulation (EC) No 1488/94 on risk assessment for existing substances and Directive 98/8/EC of the European parliament and of the council concerning the placing of biocidal products on the market.