Cowlitz River Modeling

Background

The 1980 eruption of Mount St. Helens resulted in a substantial debris avalanche on the northwest side of the mountain. The sediment which eroded from the debris field was initially retained in the sediment retention structure (SRS). However, the SRS has filled and sediment is transporting down the north fork of the Toutle River. Sediment enters the Cowlitz and moves downstream to the confluence with the Columbia River. The sediment supply to the Cowlitz exceeds the transport capacity, resulting in an aggredational river.

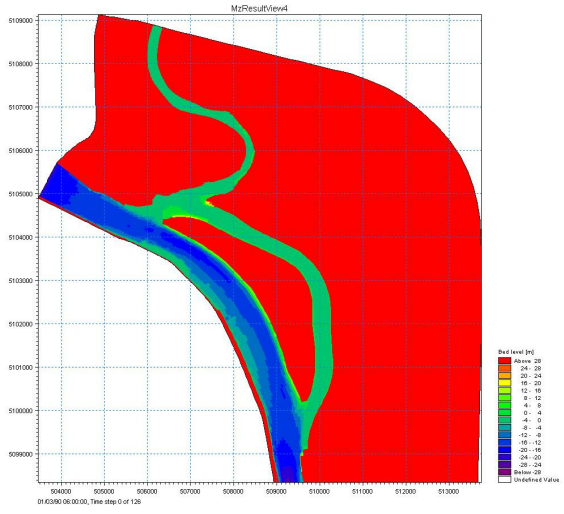

Figure 1: Model domain colored by elevation.

Sediment deposition at the confluence of the Cowlitz and the Columbia is reducing the predicted flood capacity of the channel below the authorized levels. The modeling team for the project is using numeric models 1) to quantify the amount of sediment entering the system and develop measures for reducing it, 2) use one dimensional dynamic models to route the sediment through the upper reaches of the Cowlitz, and 3) to use two dimensional models to evaluate the impact of mitigation measures at the confluence.

Alden is providing two dimensional modeling and oversight of the one dimensional modeling. In addition, Alden is providing engineering input in the selection of sediment reduction measures to be modeled and the anticipated response of the system.

Modeling Description

The numeric model MIKE21-C is being used to model the sediment dynamics at the tidal influenced confluence of the Cowlitz and the Toutle. Major modeling considerations include how to model the 3 to 5 foot tidal fluctuations in the Columbia River and the effects of transient storm events. Simulations must be designed and results must be interpreted to make quantitative predictions of how the system will respond by 2035. In making long term predictions models primarily become a tool for quantitatively comparing design options or mitigation measures. The model includes about 5 miles of the Cowlitz River and 5 miles of the Columbia River. A maximum grid resolution of about 10' x 10' is achieved.

MIKE21-C is a commercially available software package well suited to modeling sand bed rivers where water stratification can be neglected. The model solves the shallow water equations on a curvilinear grid giving a two dimensional depth averaged flow field. A variety of forcing functions are incorporated in the model including bottom shear stress, wind shear, barometric pressure, Coriolis acceleration, momentum dispersion, sources and sinks, evaporation, flooding and drying and wave radiation stresses. Seven sediment transport functions are incorporated in the model to accommodate various river bed types. The numeric scheme used in MIKE21-C is able to simulate areas with periodic wetting and drying without numeric stability problems.

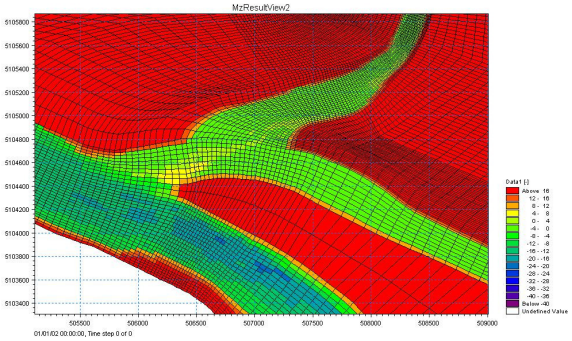

Figure 2: River confluence showing computational mesh, colored by elevation.

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