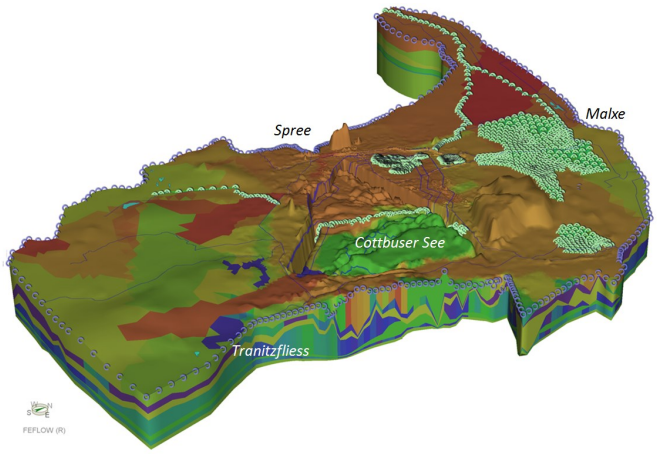
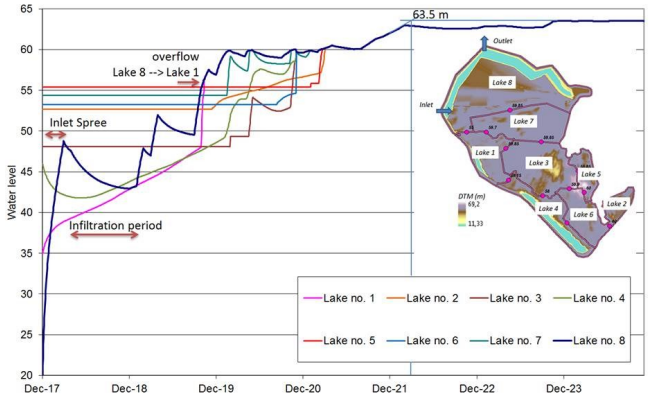
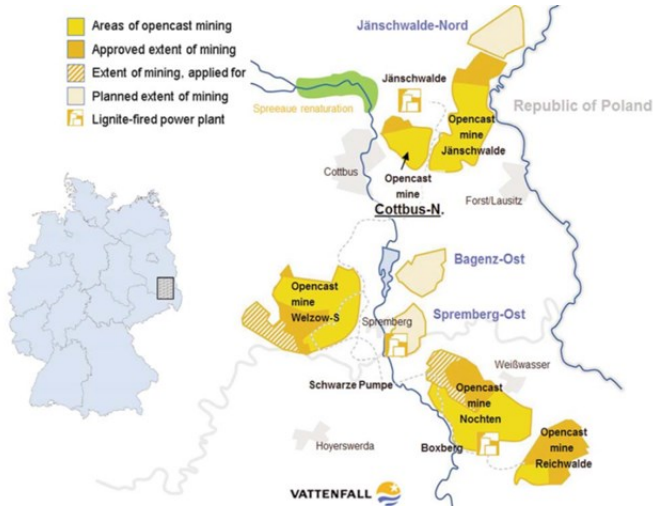


Overview of FEFLOW 3D groundwater model with applied conductivities and boundary conditions



Water level development within single lake basins with additional surface water inlet



Location of Cottbus See and the surrounding mining pits (Source: Vattenfall Europe Mining AG)

REDUCING FLOODING PERIOD

The challenge was to provide the right strategy for filling up the lake in a reasonably short period of time. This had to be done while maintaining acceptable environmental flows within the river system used to source the additional surface water required. We concluded that the time required to complete the filling of Cottbus See could be reduced significantly by using a strategy that included additional surface water inflow. The results showed that it will take approximately five years to fill up the lake to a level of +63.5 m Above Mean Sea Level (AMSL) by using additional surface water inflow from the river Spree. This means that the lake filling will be finished by around 2023. This period is more than 10 years shorter than the flooding period without additional surface water inflow and about seven years shorter than previous mine closure plans estimated.

PRECISE, INTEGRATED AND RELIABLE MODELLING PROVES ESSENTIAL

In order to achieve these results, it was essential to use integrated groundwater and surface water modelling. We used the following modelling components:

- a 3D FEFLOW groundwater model
- a MIKE 11 surface water model to describe different options for the outflow to the river Spree
- a WBalMo water and allocation model to identify long-term and optimal water allocations

By using FEFLOW and MIKE11, we were able to describe the water level development of the lake. This was done with detailed information about the inflow into the lake (groundwater inflow, surface water inflow, as well as rainfall and evaporation at the surface).

In addition to the inflow into the lake, it was important to obtain detailed information about the long-term water needs as well as the water availability of the Spree River. For this purpose, we extended and updated the water management and allocation software – WBalMo – to provide a strong basis for long-term management analyses of the Cottbus See lake. Optimisation analyses of the WBalMo model had to be restricted with respect to the maximum possible outflow discharge towards the Spree. For this reason, we first conducted hydrodynamic analyses using a MIKE 11 1D model for routes along the existing branch Schwarzer Graben, as well as for alternative routes directly towards the Spree. By applying the MIKE 11 model component, we were able to analyse the maximum outflow rate of the planned diversion system.

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