

Mine Water Management Close to Groundwater Systems of Varying Salinity, Pilbara, Western Australia

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Abstract Fortescue Metals Group (FMG) has two iron ore mining sites, Cloudbreak and Christmas Creek, in the Pilbara area, Western Australia. These mines are located in a narrow strip of land less than 10 km wide and about 70 km long and orientated in an East-West direction. The mines are located between the Chichester Range to the north and the Fortescue Marsh which is located 5-10 km to the south. The groundwater in the region is hypersaline (approximately 3-4 times the salinity concentration of sea water) beneath the Fortescue Marsh, but fresh to brackish in the mining areas. An interface between the saline and brackish waters is located about 2 km to the North of the Fortescue Marsh. Both hydrogeological analyses and previous regional scale numerical models have predicted that the interface between the fresh and saline groundwater would move toward the mining area under proposed mine-dewatering conditions. The three major hydraulic processes to consider in the model are density driven flow, mine dewatering and groundwater injection of saline and brackish water. In order to understand the dynamics of the interface between the fresh, brackish and saline groundwater, DHI was contracted to develop a high spatial resolution model (HSRM) for the Cloudbreak mining area. This model was setup with the software FEFLOW and enables FMG to predict the movement of the saline/brackish groundwater interface as well as the quantity and salinity of dewatered groundwater in each mining pit under different mining plans. Moreover, the model can be used to assess the effects of various water management plans involving dewatering and water re-injection. The model has a resolution that is suitable for a realistic prediction of the groundwater salinity interface whilst at the same time having a reasonable simulation time that allows the models to be effectively used as a planning and regulatory approval tool. With the model FMG was able to continue planning mine dewatering and reinjection operations while ensuring the environmental safety of this precious region. The HSRM modelling confirmed that the FMG modelling approach was sound and additionally minimized uncertainties in operation management. The work contributed to minimizing the risk and the optimization of the mining operations, both economically and ecologically. This will ensure that Pilbara's iron ore deposits, which contribute significantly to the economy of Western Australia, can be exploited without sacrificing the region's environmental values.

Keywords groundwater, mining, dewatering, groundwater management, salinity, FEFLOW