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title: **Implementation of a pump and treat system at Britannia mine north of Vancouver, British Columbia**

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A pump and treat system was installed at the Britannia Mine located 50 km north of Vancouver in British Columbia (Figure 1), where a dissolved metal-laden plume associated with mine tailings and waste rock discharges to Howe Sound (Zawadzki et al., 2006). Pre-remediation mass flux associated with the groundwater pathway was estimated to be approximately 10 kg/day of dissolved copper and 16 kg/day of dissolved zinc which, together with surface water releases (O'Hara and Azevedo, 2008), resulted in the site being one of the largest point sources of metal pollution in North America discharging to a marine environment.

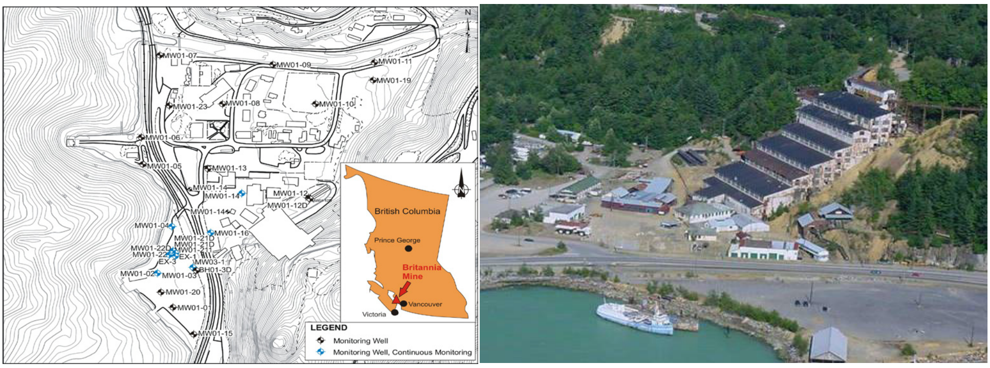

Figure 1. Site Location and Aerial View of Britannia Mine in 2005.

Hydrogeological conditions at the site are very dynamic due to tidal induced changes in hydraulic heads (approximately 2 m per tidal cycle up to 35 m away from the shoreline) and seasonal changes in the hydraulic gradients resulting from high precipitation (approximately 2.5 m/year) occurring primarily as rainfall in winter. The interpretation of site conditions is further complicated by the presence of freshwater/seawater intrusion which is also affected by daily and seasonal changes in groundwater flow conditions, and that is characterized by a highly diffuse transition zone resulting from these changes. Lastly, the presence of a major transportation corridor and old infrastructure associated with mining complicates the design and implementation of the remedial works.

Data collected during initial phases of system operation indicated that mine waste and sediments of the Britannia Creek alluvial fan were more heterogeneous than previously thought, and that a zone of higher permeability in the northern portion of the fan was responsible for an unexpected saltwater ingress into some pumping wells. A density-dependent numerical hydrogeological model of the site that was previously developed using FEFLOW (Diersch, 2009) and that simulated the freshwater plume transport and sea water intrusion was updated, and then used to optimize the wellfield. Optimization in this instance is to capture as much of the freshwater plume as practicable without inducing seawater intrusion to levels where the discharge water could not be treated. Model simulation trials indicated that pumping from two additional wells located in an inferred zone of higher permeability may improve system performance (Figure 2). Initial testing of the newly installed wells confirmed the presence of a higher permeability zone, and suggested that pumping from these wells increases overall plume capture.

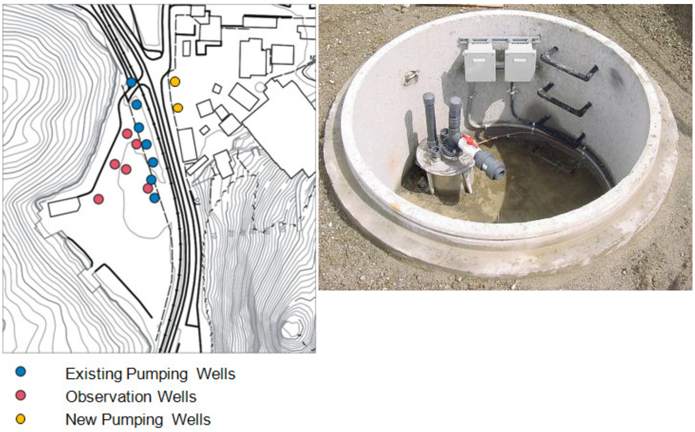

Figure 2. Pump and Treat System Components and Typical Wellhead Completion.

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