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Technical Communication

Water Management Aspects of the Britannia Mine Remediation Project, British Columbia, Canada

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Abstract. The Province of British Columbia, Canada, is undertaking environmental remediation at Britannia Mine, located approximately 45 km north of Vancouver. Britannia Mine operated for 70 years and produced mainly copper and zinc concentrates. During its operating life, and since its closure in 1974, the mine has discharged large volumes of acidic water with elevated concentrations of potentially toxic metals, including copper, zinc, and cadmium. Prior to the recent remedial efforts, metal loadings to Howe Sound averaged 300 kg/day each of copper and zinc. In addition to the acid rock drainage, mine infrastructure and mineral processing activities provide secondary sources of metal contamination of soils, sediments, ground water, and surface water. Effective water management is key to the remedial plan for the mine: ground water and surface water are the primary transport pathways for the metal contamination reaching the local receptors of Britannia and Furry creeks, and Howe Sound. The remedial concept includes diversion of clean water from entering the mine, use of the mine workings as a storage reservoir to balance seasonal flows to a water treatment plant, prior to discharging to Howe Sound via a deep outfall, and the interception of a metal-contaminated ground water plume.

Key Words: Acid rock drainage; Britannia Mine; British Columbia; mine water; remediation; water treatment

Introduction

The Britannia Mine is located at Britannia Beach on the east shore of Howe Sound, approximately 45 km north of Vancouver (Figure 1). The main mining activity was some 5 to 7 km inland from Britannia Beach, with mineral processing activities taking place at Mount Sheer, around 5 km inland, and the Britannia Beach town area on the coast, to the south of Britannia Creek. The mine site covers an extensive area, with mineral tenure associated with the mine extending over some 36.5 km2 (approximately 9,000 acres). Until the water treatment plant became operational in late-2005, the mine discharge was out of compliance with both Provincial and Federal regulations. The mine was often cited as the worst point source of metal contamination discharging to the marine environment in North America.

Figure 1. Site location

Topography

Elevation markers at the mine ascend with decreasing elevation above sea level. The zero level datum used by the mine is 1,310 m (4,300 ft) above sea level, representing the elevation of the initial surface outcrop and shallow workings located at the top of Britannia Ridge. Zero feet above sea level corresponds to the '4300 (feet) Level' [note: all references to elevation markers in the mine in this paper keep to this standard reference system as used throughout the available literature on the mine, and for consistency, are given in feet, rather than metric equivalent]. The main ore body crops out at Jane Basin, near the top of Britannia Ridge, which drops sharply to the west into Howe Sound, a fjord with only a small level alluvial fan area ('Fan Area') next to the mouth of Britannia Creek.

Mine Geology

The geology of this area can be divided into two major components: older volcanic and sedimentary rocks belonging to the Lower Cretaceous Gambier Group, and younger, plutonic rocks of the Coast Plutonic Complex. In the Howe Sound area, the plutonic rocks

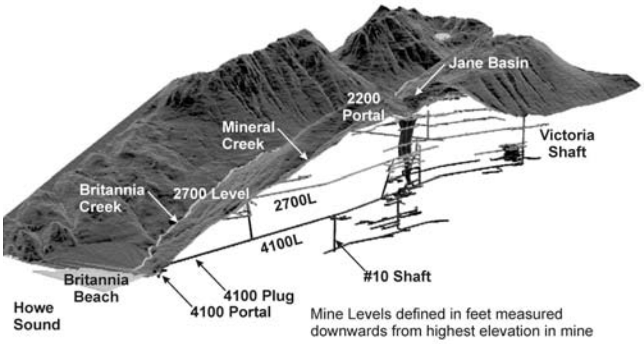

Figure 2. 3-D cutaway view of Britannia Mine viewed from the southwest

Figure 3. The southern 'Fan Area' (former main mineral processing area), showing the distinctive gravity concentrate Mill #3 structure on the hillside, the BC Museum of Mining to its left and Howe Sound in the foreground.

range in composition from diorite to granodiorite. A major feature of the mine is a broad zone of complex shear deformation and metamorphism known as the Britannia Shear Zone. This structure dips steeply south and strikes north westerly across the roof pendent and hosts all of the Britannia ore bodies, comprising a heterogeneous mixture of sulphides, remnant altered host rocks, and discreet mineralized veins (Price et al. 1995).

Mine History

The Britannia Mine was operated from 1905 to 1963 by the Britannia Mining and Smelting Company Ltd. and from 1963 to 1974 by the Anaconda Mining Company. At its pre-World War II peak, the mine was reportedly the largest producer of copper in the British Empire. The mine was closed in 1974 and since then has remained largely derelict. A concrete plug fitted with stainless steel pipes and valves was installed in the lowest major entry (400 m into the 4100 Level adit) in 1978, to allow the control of water flowing from the mine to a copper precipitation system located nearby and also for safety reasons (prevention of uncontrolled 'mudrushes' from the 4100 Level portal). The 4100 Level (Figure 2) exits immediately to the east of the concentrate mill (Figure 3).

Seven ore bodies were mined through a combination of open pit, glory hole, and underground developments. Approximately 80 km of underground workings, numerous stopes, and four open pits were developed to extract some 48 million tonnes of ore. The main access points to the mine were through the open pits and glory holes associated with Jane Basin, various portals at the 2200, 2700, and 4100 Levels and the Victoria shaft (located to the south in the Furry Creek watershed).

Since the mine ceased operations, surface water continues to enter the mine workings, predominantly through the open pits and glory holes in the Jane Basin area. Prior to the recent remedial work, drainage from the 2200 Level was to Britannia Creek, and the 4100 Level drainage was directed to a discharge pipe into Howe Sound, some 26 m below sea level.

Regulatory Background

The Provincial regulator, the BC Ministry of Environment (BCMoE) is responsible for ensuring that the remediation activities undertaken at the site bring the mine into compliance with the requirements of the (then) Waste Management Act (now the Environmental Management Act) /Contaminated Sites Regulation and other pertinent provincial legislation. Environment Canada and the Department of Fisheries and Oceans are responsible for ensuring that Federal requirements are satisfied by the remedial actions implemented at the mine.

Technical Studies

The Province appointed Golder Associates Ltd. (Golder) as overall Project Manager for the Britannia Mine Remediation Project in 2001. Technical consultants were subsequently appointed to evaluate major technical areas associated with developing a remedial concept for the site: mining and hydrogeology, contaminated soil/ ground water, water treatment, outfall location, and flood risk. Technical reports from these studies can be downloaded from the Province's website (www. britanniamine.ca).

The major technical studies all coupled into a water treatment plant feasibility study (Figure 4). The contaminated soil and ground water investigations included a preliminary assessment as to whether contaminated ground water should be captured (extracted) from the Fan Area as a remedial action and, if so, what quality and quantity would require treatment in the plant. The need for a flood risk

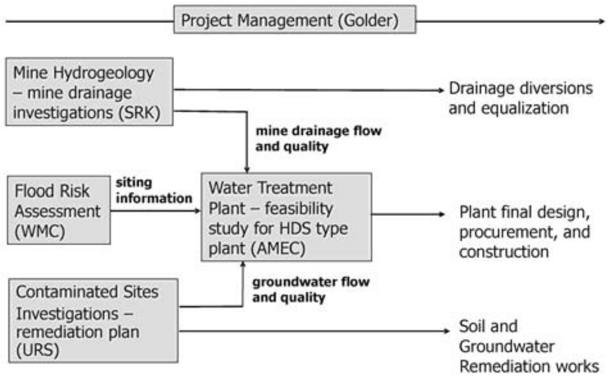

Figure 4. Major technical studies all coupled into the water treatment plant feasibility study

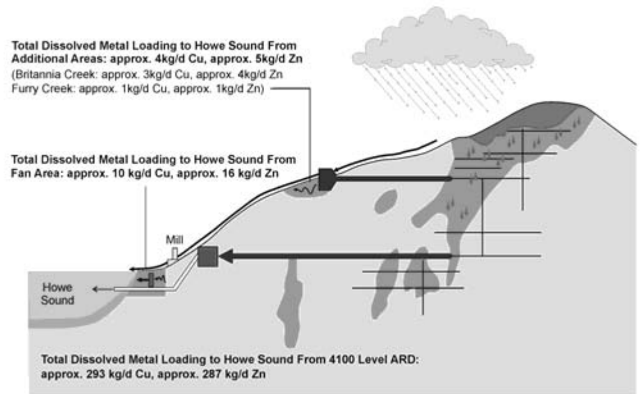

Figure 5. Pre-remediation contaminant loading estimates

assessment was also identified as some of the locations being considered for the water treatment plant, as well as for other remedial measures, were potentially within the flood plain of Britannia Creek.

The major technical studies were completed in late 2002 and were followed in 2003 by implementing a number of interim remediation measures and long-term remedial planning.

Environmental Issues

Acid Rock Drainage (ARD)

The quality of water draining from the mine workings was both a benefit and a problem during the life of the mine. The benefit was that the concentration of copper allowed direct precipitation of large amounts of copper from the discharge water (Steffen Robertson and Kirsten Inc 1991). However, the negative aspect of the mine water discharge, which typically has a pH of ≈ 3.5, with elevated concentrations of dissolved copper, zinc, and cadmium, is the adverse impact of these metals in the aquatic environment (Chretien 1997).

Following mine closure, the majority of this water discharged from the 4100 Level (to Howe Sound) and the 2200 Level (to Britannia Creek). About 5 million m3 of water typically drained through the mine annually; the daily load of copper and zinc discharged to Howe Sound averaged almost 300 kg each (Figure 5).

Contaminated Soil and Ground Water

The second environmental issue at the mine is the presence of large quantities of mineralized rock, waste rock, tailings, remnant concentrate, and other process wastes at various locations on the property. The largest accumulations of these materials (except in-situ in the Jane Basin open pits) is in the Fan Area in the southern portion of the Britannia Beach area (Figure 3), the 2200 and 2700 Levels, and the Victoria camp areas. The primary transport pathway for contaminants in soils is by leaching and then by surface water and/or ground water flow. This issue is of particular concern along the shoreline of Howe Sound, where, prior to the implementation of recent remedial actions, an estimated average of 10kg/day of copper and 16 kg/day of zinc discharged daily from the site via ground water into the inter-tidal zone.

Offshore

Over 40 million tonnes of mine tailings were deposited offshore of the site in the deeper waters of Howe Sound during the operational life of the mine. Environment Canada investigated the nature and distribution of these tailing deposits and recommended that no intrusive remedial action be taken as these deposits are beneath the photic zone, the metals contained therein are generally not bio-available, and are being gradually buried by clean sediments from the Squamish river (Hagen et al. 2004). The Province's remediation project does not include addressing these materials.

Remediation Project

Remedial Concept

The acceptable level of remediation at the site was determined using a risk-based approach. This required a thorough understanding of the baseline environmental conditions and an appropriate system to monitor improvements in water quality. Figure 6 illustrates the remedial concept developed by the Province. Although Britannia does not suffer from 'classic' ground water rebound, as metal contaminated water has always discharged from the mine, it was evident that the key to successfully remediating the

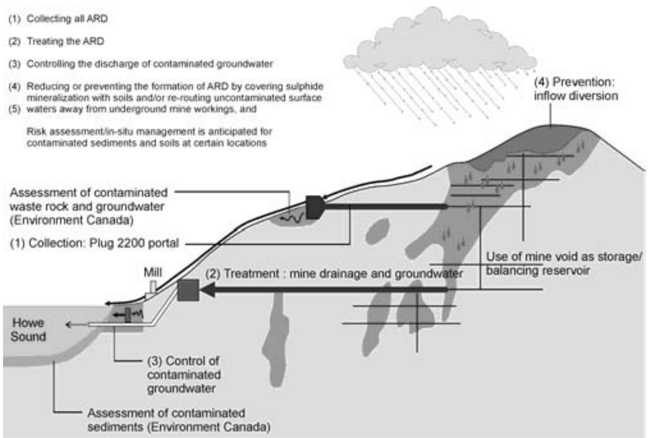

Figure 6. The Province's remedial concept

mine was efficient water management on a variety of fronts.

The ARD discharging from the 4100 Level represented some 95% of the metal contaminant loading to Howe Sound from the mine and was therefore the main focus of the Province's remedial concept. Although an obvious remedial action would be to prevent surface water inflow into Jane Basin, it was clear that this would be very problematic due to the physical nature of the open pit and glory hole mining complex, which has an extensive area of talus slopes and fractured bedrock over the area of infiltration (several hectares). It was concluded that additional fieldwork would be required to adequately evaluate the feasibility of (clean) surface water diversions, including seasonal measurements of creek flows into the glory holes and of ephemeral water flows during the early-summer snow melt period.

It was also necessary to ensure that most of the ARD report to a single discharge point (at the 4100 Level) to allow delivery to a single water treatment plant by re-directing mine water discharging from the 2200 Level portal back into the mine. This was achieved in late 2001, through the combined effort of the University of British Columbia and the (then) mine landowner, by installing a concrete plug in the 2200 Level adit.

The volume of the ARD discharge from the mine varies seasonally, peaking in the early summer due to snow melt (freshet) and then again in late fall, at the onset of the early winter rains and prior to freezing conditions and snow accumulation in Jane Basin. To mitigate this seasonal variation in the mine discharge rate (up to an order of magnitude, typically ranging from 40 to 400 L/sec), the Province identified that part of the mine workings could, potentially, be used as a storage reservoir, regulating the flows to the water treatment plant. This concept required a detailed knowledge of the passage of water through the mine workings, coupled with establishing an elevation versus volume relationship for the part of the mine to be used for storage, together with an evaluation of a number of safety concerns. The latter included the integrity of the 25 year old concrete plug located in the 4100 Level adit, stability issues associated with other mine entries and the general water-tightness of the mine host rock under elevated pressures resulting from water storage in the mine workings. Storing water in the mine by flooding sections of previously un-wetted mine workings was also identified as having the potential to affect the chemistry of the stored water prior to discharge. These issues needed careful investigation, including full-scale flooding exercises of the mine workings. Flow to the plant would be controlled by valves located on the pipes installed in the existing concrete plug located in the 4100 Level adit. Appropriate regulation of flow would allow optimization of plant size and operating methodology to allow the most economic plant design to be adopted.

The second major component of the Province's remedial concept was to address the various contaminated soils/ground water issues across the site. The major issue was the metal-contaminated ground water leaching from the former mineral processing operations and mine infrastructure, and in particular, discharging through the metal-contaminated alluvial fan of Britannia Creek to the environmentally sensitive shallow marine environment of Howe Sound.

Implementation of Water Management at the Mine

The remediation is being implemented in a staged approach. A Stage 1 remedial action plan (Stage 1 RAP) was developed by Golder in March, 2003 with implementation commencing in June, 2003. The Stage 2 RAP commenced in early 2004 and will continue through the end of 2007 with the completion of the Tier 2 risk assessment.

Water management aspects of the Stage 1 RAP included:

- Additional ground water investigations in the Fan Area to help ascertain whether a ground water capture system would be the most appropriate long-term remedial action to deal with the local ground contamination issues. A new pumping well was installed and a long-term ground water pumping test was undertaken, coupled with a program of more detailed ground water modelling designed to establish the feasibility and most appropriate method of ground water control, pumping rates necessary to affect this control, the quality of the pumped ground water, and the anticipated longevity of the installed systems in such aggressive conditions;

- The detailed site investigation indicated that the Fan Area storm water drainage system was significantly contributing to metal loading of the surface waters of Howe Sound. Installation of surface and shallow ground water drainage improvements in the southern Fan Area was therefore a component of the Stage 1 RAP, comprising a system of lined surface swales, catch pits, sediment traps, pipework and the installation of a storm water interceptor sewer. This system collects run-off water from metal-contaminated mine waste materials accumulated on the slopes above and adjacent to the concentrate mill and from surficial soils across the southern half of the Fan Area, discharging to the old deep outfall; and,

- Identifying surface water diversion opportunities in the Jane Basin and Victoria mine areas and undertaking the associated engineering design and cost-benefit analysis.

An overall mine closure and remediation plan (ORP) was developed for the site by Golder in 2003 and submitted to the BCMoE. The ORP addressed all aspects of the site remedial planning, including contaminated soil and ground water remediation, water collection and control, the water treatment plant, outfall and disposal of contaminated soils and water treatment plant waste products (e.g. sludge), with the exception of the mine tailings deposits in Howe Sound.

The Stage 2 RAP was developed as part of the ORP, and included the following water management measures:

- Construction of surface water diversions in and around the Jane Basin area and the Victoria glory holes;

- Finalizing the water treatment plant performance specifications to obtain a discharge permit from BCMoE.

- Procurement, construction, commissioning and operation of the ARD water treatment plant and its associated infrastructure, including the influent water control, underground mine rehabilitation, and a new deep outfall system. In mid-2003, the Province elected to procure the water treatment plant through a design-build-finance-operate (DBFO) contract within a public private partnership. The plant was to be supplied on a performance-based approach, whereby the technology was not specified (thus giving greater opportunity for innovation and reduced risk to the Province), but any proposed system must be technologically sound and proven in the industry. The water treatment plant contractor would finance the construction of the plant and would, once operational, receive periodic payments from the Province based on the volume of water treated to the specified standards,

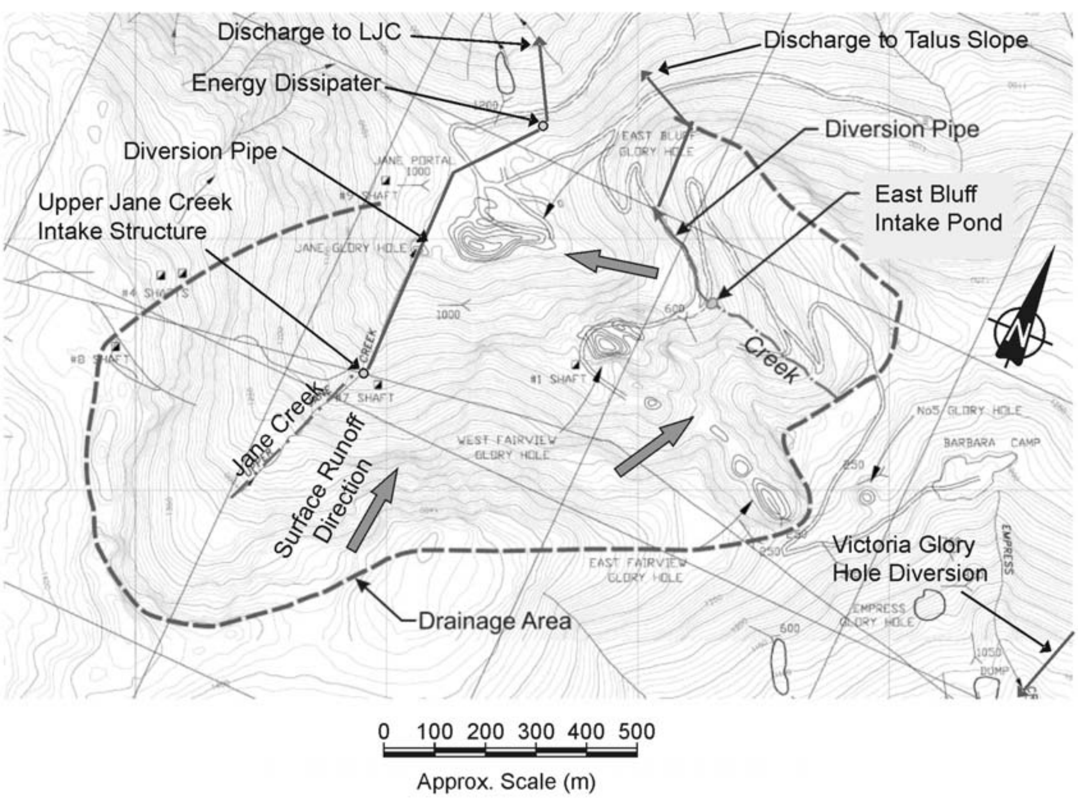

Figure 7. Surface water diversions

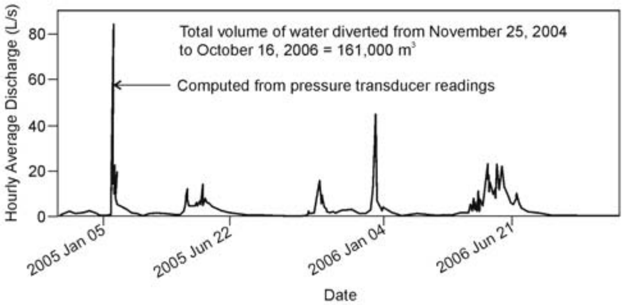

Figure 8. Hydrograph showing East Bluff Diversion performance

Figure 9. Water treatment plant

together with capital/debt service and other fixed operational costs;

- Selection of a ground water control system for the Fan Area and its implementation. The Stage 1 RAP identified a number of options for ground water capture, including various arrangements of pumping wells, scavenger wells, and barrier walls. One of the technical challenges was the high chloride level of ground water in the coastal margin of the Fan Area and therefore its potential to be highly corrosive to the wells, pumps, infrastructure, and water treatment plant components, and to affect the water treatment process; and,

- Further improvements to surface water drainage across the mine site, including the Fan Area, 4100 Level bench and the 2200 Level waste dump.

Surface Water Diversions

The Stage 1 RAP included studies assessing the feasibility of a series of possible surface water diversions around Jane Basin and Victoria glory holes, the latter within the Furry Creek watershed (Figures 2 and 7). The Stage 2 RAP included the construction and ongoing evaluation of these diversions. Of particular benefit is the ability of these systems to shave-off the peak flows, which will reduce the possibility of plant by-pass events.

A diversion was constructed along East Bluff in the fall of 2004 using a simple soil/membrane berm intake structure, ditch and pipe system located adjacent to one of the old mine access roads. This system was improved in 2005 by changes to the intake structure and by extending the discharge arrangement to prevent suspected short-circuiting back to the Jane Basin glory hole complex. The system currently discharges onto a talus slope, than flows into the Britannia Creek catchment. This diversion was monitored through the winters of 2004/5 and 2005/6 (Figure 8) and demonstrated a payback in terms of savings on water treatment in the order of 6 years.

The Upper Jane Creek diversion was constructed during 2005 in very steep terrain with difficult access, immediately south of Jane Basin, and was operational by Fall of that year. This system is significantly more complex than the East Bluff system, comprising a concrete intake structure and V-notch weir, feeding into a manifold pipe having four valved 100 mm lines installed at varying elevations on the manifold. The 100 mm lines are bundled together and run across the entire width of Jane Basin, feeding into a concrete energy-dissipation chamber and then discharging into the Britannia Creek catchment. The four-pipe bundle and manifold system was designed to minimize the potential for system freezing in low flow conditions at the 1000m elevation of Jane Basin by maximizing the flow in one pipe before flow starts in the next. This system was monitored during the winter of 2005/6 and exceeded expectations; improvements to the discharge arrangements commenced in 2006 and continue into 2007.

A third surface water diversion structure was implemented in the Victoria Mine area in the Furry Creek catchment in 2005. This is a relatively simple diversion, designed to capture the short-lived but high volume ephemeral surface water flows above the Victoria glory holes. This system comprises a soil/membrane intake structure and pipe discharging to Empress Creek/Furry Creek. This system was also monitored during the winter of 2005/6; however, failure of the datalogger resulted in little recorded data. Visual observations made during the freshet period of late-spring/early summer 2006 indicated that the system functioned as expected.

Water Treatment Plant

As noted above, the Province elected to procure the water treatment plant under a DBFO contract. The basic scope of this contract included:

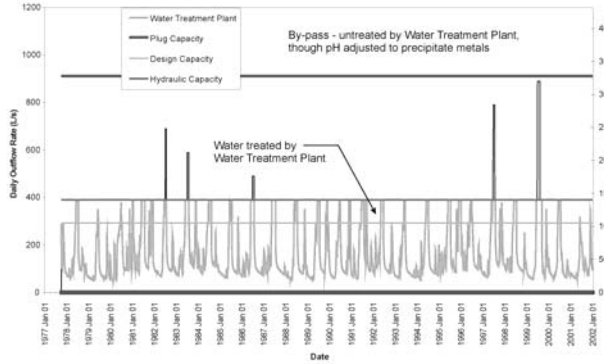

Figure 10. Mine reservoir management – typical model run showing no uncontrolled reservoir overtopping events and five controlled plant by-pass events during the modelled 25 years

- Construction of a 1,050 m³/hour high density sludge (HDS) water treatment plant (1,400m³/hr hydraulic capacity) to be located on the 4100 Level bench, immediately east of Britannia Beach (Figure 9);

- Construction of the new deep water outfall, south of Britannia Beach;

- Rehabilitation of the 4100 Level tunnel from portal to plug;

- All ancillary facilities for the plant, including water control and conveyance from the mine;

- Disposal of waste products from the water treatment process (sludge); and,

- Operation of the plant for 20 years.

The successful proponent was EPCOR Water Services Inc. (EPCOR) and the ground-breaking ceremony for the water treatment plant took place on March 3, 2005; the plant became operational by mid-October of the same year and was compliant with the BCMoE discharge permit by early-2006.

A micro-hydro power plant deploying turbines powered by the mine water discharging from the workings via a penstock from the 4100 Level plug was also completed as part of the DBFO contract. This system was undergoing operational trials in early-2007. The DBFO contract also included the design and construction of a new (50 m) deep outfall for the treated effluent from the plant. This comprises some 1.2 km of onshore pipework and around 200 m of offshore pipework, replacing the dilapidated outfall previously used for the untreated mine water. This system was constructed in the fall of 2005, prior to plant start-up.

Approximately 3,000 m³ of sludge per annum will be disposed in the Jane Basin open pits on the mine site: any leachate from this material will return to the mine workings and to the water treatment plant (AMEC 2002).

Mine Reservoir Management

As noted previously, the water treatment plant capacity was based on the concept that the mine workings could act as a storage (balancing) reservoir, accommodating excess flows during the fall rains and spring freshet periods, which can be up to an order of magnitude higher than in the mid-winter and late-summer flows, thus allowing a smaller, more efficient treatment plant to be suitable. The mine inflow model developed during the technical study phase of the project, which used the University of BC (UBC) watershed model to simulate underground storage effects in the mine, was modified by Golder to allow the effects of a series of different reservoir operating rules to be modelled to assess optimal plant capacity and the frequency of any (controlled) plant bypasses and the potential for (uncontrolled) reservoir overflow events (Figure 10). The project was fortunate in that mine outflow records were available for about 25 years following mine closure, including a 1:50 year discharge event (1999). As long as the reservoir was operated under such rules, the modelled results indicated that over a similar 25 year period, a plant with a design capacity of 1,050 m³/hr and a hydraulic capacity of 1,400 m³/hr, would perform well, specifically:

- the reservoir would not overtop, even during a (simulated) 1:200 year discharge event;

- up to five discharge events could occur that would require partial bypass around the water treatment plant, during which the bypass water would be treated by lime addition only and then blended with the fully treated water passing through the plant; and,

- around 97% of the water discharging from the mine over a similar period would be fully treated to permit requirements.

The modelling also illustrated that in order to avoid all bypasses of the plant, a treatment plant of around three times the capacity would be needed. Such a plant would be very expensive and inefficient in its operation. Following consultation, the BCMoE acknowledged that the proposed plant and operating rules were appropriate for the circumstances and integrated these into the discharge permit.

EPCOR is responsible for mine reservoir management, having full operational control over mine water levels

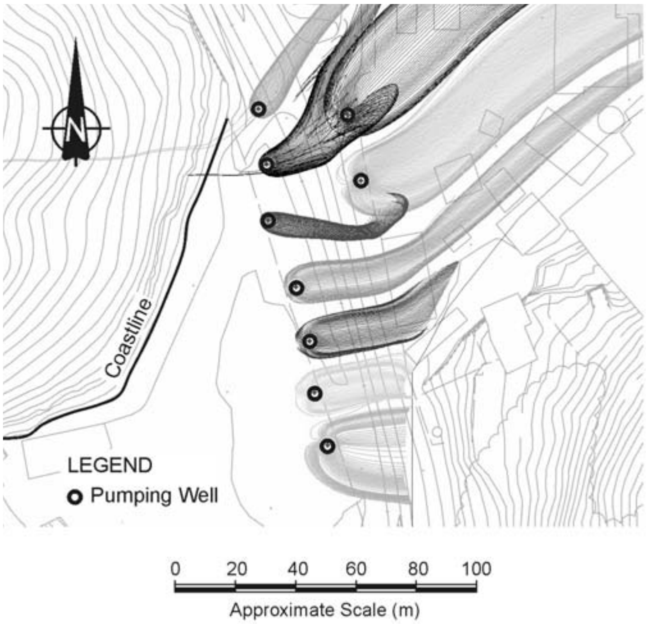

Figure 11. Ground water management system – modelled capture zone with nine pumping wells operating

Figure 12. Ground water pumping system – flow meter and conductivity sensor array

and discharge rate to the plant/micro-hydro. However, the Province acknowledges that the mine is a dynamic system, subject to temporal changes resulting from internal changes in the mine, outside the control of the operator, e.g., due to collapse of the workings, and the Province therefore bears the risk for gross changes of this nature.

Ground Water Management System

Ground water flow was modelled using FEFlow, a finite element 3-D numerical modelling software capable of simulating flow of variable density fluids, the latter necessary due to the proximity of the saline waters of Howe Sound. System concepts considered, and explored using the model, included various combinations of barrier walls, injection wells, and pumping wells, targeting best-value maximum fresh ground water capture efficiency, while limiting pumping rate of the system to 100 m^3/hr with a maximum salinity of < 1000 ppm in order to meet design criteria for the water treatment plant. The system concept adopted consisted of seven pumping wells in a linear array sub-parallel to the shore line, coupled with an associated monitoring well array. The pumping rate for the individual wells in the array has to be determined dynamically, based on conductivity, flow, and pressure data.

Except for the well installations themselves, the ground water management system was procured under the DBFO contract. It was therefore logical for that contractor to help in the design, construction, and commissioning of the system to ensure full compatibility of the control and data management systems with those of the water treatment plant.

The pumping wells were installed in late 2004 and construction of the remainder of the ground water management system commenced in March, 2005, with commissioning in late May, 2005. At this time, the initial optimization phase of the system has been completed. Some wells were found to have significantly higher salinity than predicted by the modelling and their flows had to be reduced accordingly, resulting in a relatively low capture efficiency. More recent modelling, calibrated on the results of the initial optimization phase, has resulted in a recommendation to install two additional pumping wells in the system, located further inland. The modelling predicted capture efficiencies on the order of 90% with these wells installed (Figure 11). Procurement of the new wells and associated infrastructure is underway.

Untreated ground water from each of the wells is piped to a central location (pumphouse, Figure 12), where flowrate and electrical conductivity is measured and recorded in a SCADA system, and it is then pumped to the water treatment plant using transfer pumps and a forcemain.

Optimization of the ground water management system will be going on for at least another year, with iterations of observed versus modelled data being used to assess and maximize capture efficiency. After that, the environmental monitoring and ecological risk assessment programs will determine if the capture is achieving the desired environmental endpoints or whether additional wells or other measures are required to enhance the system.

Monitoring Program and Ecological Risk Assessment

A preliminary site-wide monitoring program was undertaken in late-2001 to establish baseline conditions prior to commencement of intrusive site investigation activities. An ecological baseline survey was completed in 2003, designed to establish the (then) environmental conditions at the site for comparison to conditions during and after implementation of the major remedial actions. A long-term environmental effects monitoring (EEM) program and Tier 2 risk assessment commenced in late summer, 2004 and will continue until the end of 2007 to measure the success of the remediation efforts and optimize environmental protection. Ongoing monitoring includes detailed assessments of sediment and water chemistry, flora and fauna near the mine site and at a number of reference sites along Howe Sound, sufficient to allow detection of changes during and after remediation. The Tier 2 risk assessment is designed to identify the need for and to focus any additional remediation efforts at the site and to assist in establishing monitoring and reporting requirements after the EEM program.

Conclusion

The Britannia Mine Remediation Project has addressed the environmental issues summarized in this paper with a comprehensive program of integrated and cost-effective remedial actions. The program is now in the latter stages of implementation, with all major capital programs having been completed by the end of 2005, with a significant improvement in discharge water quality (Figure 13). A combined monitoring program and risk assessment designed to confirm that these actions have been successful in remediating the mine site to the requirements of Provincial and Federal regulatory agencies is underway. The results of the risk assessment will be used to determine if additional remedial actions are necessary. Thereafter, an ongoing program of operation and maintenance of the remedial components, and in particular the water treatment plant and ground water management system, together with an element of environmental monitoring, will continue for the foreseeable future.

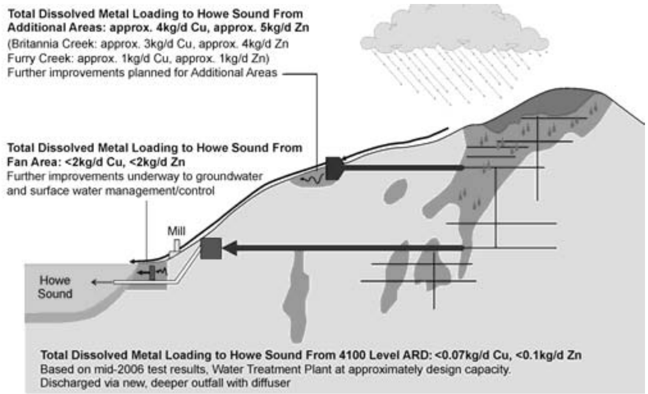

Figure 13. Post-remediation contaminant loading estimates (as of 2006: further improvements underway)

In addition to the environmental remediation work at Britannia discussed in this paper, there are many other improvements planned or underway near the Britannia Mine, for which the environmental improvements acted as a catalyst. These include a large amount of subdivision development work within and adjacent to Britannia Beach, resulting in upgraded roads, bridges, a new potable water supply and sewage treatment facilities, and other infrastructure enhancements. Also, the B.C. Museum of Mining, located on the former mineral processing area on the Britannia Creek alluvial fan, has commenced their Britannia Project, including rehabilitation of the iconic Mill #3 at the site (Figure 3), which is being rendered structurally sound, and receiving new cladding, glazing, and roofing courtesy of both government and private funding.

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