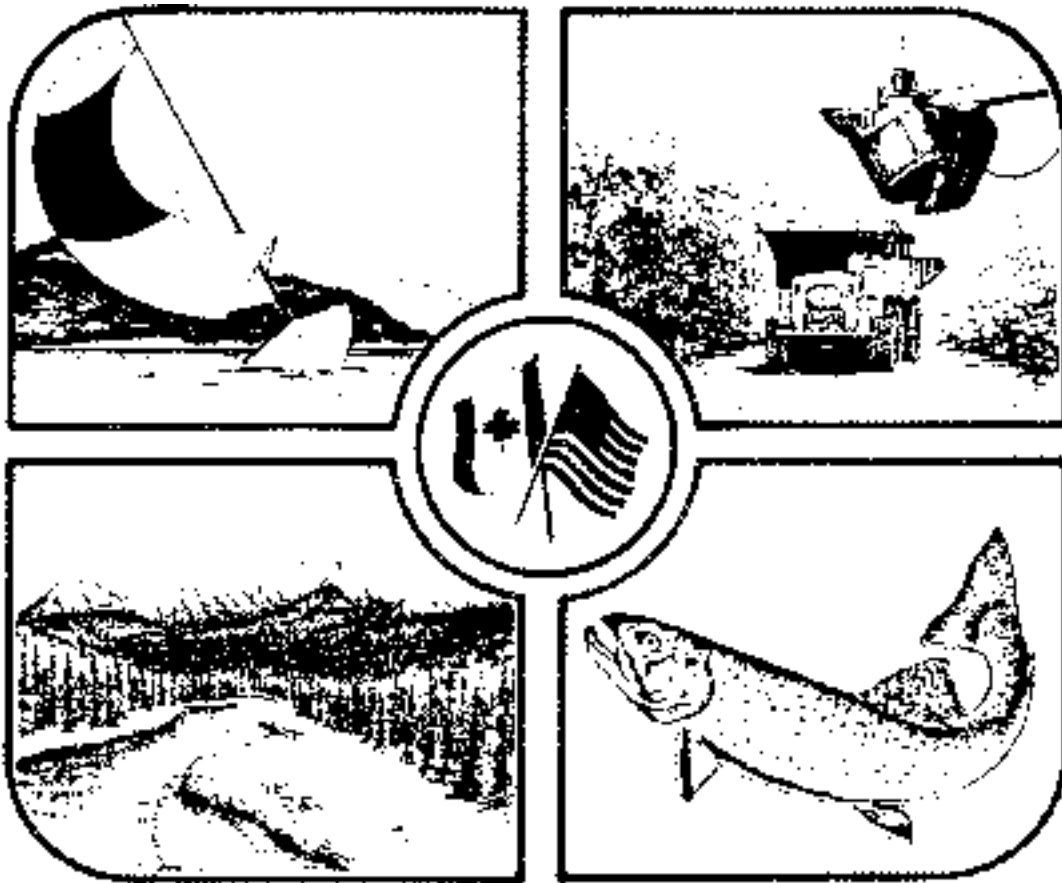


# Flathead River International Study



International Study Board Report  
Summary and Conclusions  
June, 1988

## Background

The following is a brief outline of the background to the Flathead River International Study Board's report, and a summary of its conclusions. No attempt has been made, however, to summarize the baseline component of the study. Readers who wish further information regarding baseline conditions are referred to Section Three of this report, and to the reports from various supporting technical groups.

In February 1984, the British Columbia government granted Sage Creek Coal Limited approval-in-principle for a 2.2 million tonnes (2.4 million U.S. tons) per year thermal coal mine located 10 km (6 mi) upstream from the International Boundary on Howell and Cabin creeks, tributaries to the Flathead River. The mine plan is based on 21 years of mining at this rate. Coal reserves, however, exist for a further 20 years of mining at the same rate. The Board has not assessed the potential impacts of extending the life of the mine.

The United States and Montana governments were concerned about the possible effects of this proposed mine on the Flathead River system, Glacier National Park, and Flathead Lake in Montana. The centerline of the North Fork Flathead River, from the International Boundary to the confluence with the Middle Fork Flathead River, is the western border of Glacier National Park. In addition, the park has been designated as a Biosphere Reserve by the United Nations Educational, Scientific, and Cultural Organization (UNESCO), and has been nominated as a World Heritage Site. The North Fork Flathead River has been designated as a component of the U.S. National Wild and Scenic Rivers system. Montana has classified the water quality of the North Fork Flathead River as Class A-1, the state's highest water quality classification, and has also established a non-degradation standard for these waters.

In response to these concerns, the United States and Canadian governments requested that the International Joint Commission examine the possible impacts of the proposed mine on water qual-

ity and quantity, fisheries, and water uses of the Flathead River at the International Boundary and downstream through Flathead Lake. The Flathead River International Study Board was established to undertake this investigation and to report its findings to the Commission.

The Board appointed four technical committees, a special sub-committee, and a task force, to describe the existing environmental conditions and water uses in the study area, and to assess the potential changes to those conditions that could arise as a consequence of the development, operation, and reclamation of the proposed mine. These groups were the Mine Development Committee (MDC), the Water Quality and Quantity Committee (WQQC), the Biological Resources Committee (BRC), the Water Uses Committee (WUC), the Water Quality Criteria Sub-Committee (WQCSC), and the Limnology Task Force (LTF).

The Board was requested in its terms of reference to use existing information, or any which might become available during the analysis. For the proposed mine the Board was to base its assessment on the current proposal, with the conditions attached as part of its approval-in-principle.

The Board encountered two major problems in meeting the terms of reference established by the Commission. First, the mine plan is only at a conceptual level of design. This level of design (called Stage II) is generally adequate to consider approval-in-principle under British Columbia's Mine Development Review process, but is not adequate to develop reliable, quantitative predictions of impacts on water quantity, water quality, or biological resources at the mine site or at the International Boundary. A more detailed level of design (called Stage III), required before specific permits and licenses can be granted by the British Columbia (B.C.) government's regulatory agencies, would be necessary before predictions of many of these impacts can be made with confidence. Second, the baseline data required to assess the impacts of the proposed mine are generally not adequate; thus the Board and its

technical committees often had to use professional judgment when developing conclusions, rather than basing them on data.

As a framework for assessment by the committees, the Board developed two cases for mine site operation to provide a range of discharges and possible impacts. The “optimal” case was considered to represent the most desirable situation, whereby the mine would employ state-of-the-art environmental control technology and would operate in compliance with all legislative and regulatory requirements. To accomplish this, it is assumed that certain mitigative measures would be applied that generally have not been required at other operating mines. The “adverse” case represented operating conditions where, despite the use of the best practical technology, there would be occasional failures to meet specified requirements. The Board notes that both of these operating cases assumed adherence to the Stage II design. The Board used information from existing mines in the Elk River basin to develop this adverse case, but cautions that transferring these data is difficult, in part because the environmental control technology at the proposed mine will be different from that at the existing mines.

The BRC, however, based on its interpretation of current coal mining practices in southeast B.C., and its observation that strict adherence to Stage II mine plans is without precedent in British Columbia, defined its optimal and adverse cases differently from the Board. Consequently, the BRC’s impact assessment does not represent the same range of conditions as that developed by the MDC and used by WQQC. While this redefinition of the Stage II mine plan created a problem for the Board in its own assessment, it did demonstrate that environmental concerns must receive special attention. If either the Board’s optimal or adverse conditions are to be achieved.

## Conclusions

### Water quantity

The Committees and the Board were unable to distinguish between the optimal and adverse cases in assessing changes in water quantity. The

Board concludes that in neither case will the mine have significant effects on water quantity at the International Boundary.

The effects of the mine on Cabin and Howell creeks at and immediately downstream of the mine site are difficult to predict because of the complex interrelationships between surface and ground-water hydrology. In the pre-mining phase, there is a potential for increased flow in these creeks during freshet due to land clearing, and reduced flows during base flow periods due to decreased ground-water discharge. During the early phases of mining, net flows in these creeks are expected to change less than 10 percent due to the counterbalancing of increases from ground-water infiltration and decreases in surface flows due to diversion into the Flathead River. In the later stages of mining, once the pits extend below the valley floor, there is a possibility of reversals in ground-water flows resulting in loss of water from Howell and Cabin creeks to the pits. The probability, and the magnitude, of this loss is unknown because of the present poor understanding of the ground-water regime.

**Stream morphology.** No significant changes are expected to the morphology of Cabin and Howell creeks if, as proposed in the Stage II report, the extent of rip-rapping is limited, and if the streams are allowed to meander within the largely unaltered buffer strip. The B.C. government has stipulated that a 90-m wide, undisturbed buffer strip is to be maintained along the banks of Howell and Cabin creeks as a condition for the development of this mine. The Board notes, however, that this level of protection is unprecedented at coal mines operating in B.C.

### Water Quality

**Sedimentation.** The Board concludes that there will be increased sedimentation due to the mine. Under the optimal case the increase in sediment loads and concentrations at the International Boundary would be insignificant. Under the adverse case the maximum increases in loads and concentration at the International Boundary would be in the order of five percent due to sedi-

ment yields from the mine site. Little information exists to quantify sediment yields from non-point sources beyond the mine site such as the proposed haul road to Morrissey and the power line corridor.

The Board concludes that, at the mine site, under the adverse case, sediment will be generated during the pre-mining and land-clearing phase and that some of this sediment will be deposited in the creeks. During the mining phase, during freshet and in summer storms (averaging four occasions per year), increased suspended sediment concentrations in Howell and Cabin creeks will exceed the ambient objectives set by the B.C. government of 10 milligrams per litre (mg/L) increase above background and the WQCSC no-effect level (NEL) criteria for maximum instantaneous concentrations. Under the optimal case, the increases in suspended sediment concentrations will not exceed the B.C. objectives but may exceed the WQCSC NEL criteria at times.

Generally, the Board believes that in both the adverse and optimal cases, most of the additional fine sediment will be flushed out of Cabin and Howell creeks during freshet. There will be some deposition of fine sediments in stream gravels in areas of lower than average stream velocity and also in the late stages of freshets; some of this sediment may persist for some time and may exceed the WQCSC NEL criteria for deposited sediments.

**Turbidity.** The Board concludes that there will be an increase in turbidity associated with the increase in suspended sediment concentrations. Under the optimal case changes in turbidity would not be visible at the International Boundary. In the adverse case the maximum increase in turbidity at the International Boundary is expected to be about 10 percent. This would occur typically during freshet and during summer and fall rainstorms when sediment concentrations, and hence turbidity, are already high. The Board has been unable to determine whether such an increase in turbidity would be visible.

**Temperature.** Changes in surface water tem-

peratures at the International Boundary are not expected to be significant under either the adverse or optimal operating cases. Under the optimal case the temperature change in Howell and Cabin creeks is expected to be between -1 and +1°C (-1.8°F and +1.8°F). Under the adverse operating case temperature changes of -2 to +3°C (-3.6°F to +5.4°F) are possible depending on the amount of ground water upwelling into these creeks, the timing and location of pond discharges, and the possible loss of surface water to the pits. These changes would exceed the B.C. objectives of +1°C (+1.8°F) and the WQCSC specific criteria for temperature.

**Nutrients and Toxic Compounds of Nitrogen.** The Board is primarily concerned with increases in phosphorus (P) and nitrogen (N) in their various chemical forms, notably biologically available phosphorus (BAP), nitrate, and the toxic forms ammonia and nitrite. It concludes that, even under the adverse operating case, total BAP loadings to Flathead Lake would increase by less than one percent and thus would not contribute measurably to eutrophication (enrichment) of the lake. Based on existing information the Board is unable to determine whether the increase in P concentrations at Howell Creek will exceed the B.C. objectives or the WQCSC NEL criteria for soluble reactive phosphorus (SRP), for either the optimal or adverse cases, because it is not known where the material will enter the creeks. These objectives and NEL criteria will likely be exceeded at the International Boundary under either case, because of the zero-increase objective for receiving waters.

The predicted increase in N will exceed substantially the WQCSC NEL criteria, but not the B.C. objectives, for Howell Creek and for the Flathead River at the International Boundary under both the optimal and adverse cases.

The Board feels that there will be significant increases in nitrite and ammonia concentrations in Cabin and Howell creeks due to blasting residues that contain large amounts of nitrates. The Board concludes that, to the extent that there is a groundwater connection between sources of ni-

trite and ammonia and the streams, concentrations of these compounds would exceed the B.C. objectives and the WQCSC NEL criteria resulting in toxic levels in the spawning areas in Howell and Cabin creeks under both the optimal and adverse cases. The Board also concludes that the nitrite and ammonia will probably be oxidized to non-toxic nitrate before reaching the International Boundary.

**Other Water Quality Parameters.** The Board also considered the effects of the mine on total dissolved solids (TOS), dissolved oxygen (DO), metals, and pH. The Board is unable to conclude, due to insufficient information, whether metals are likely to pose a problem anywhere in the study area, including the International Boundary. With the possible exception of DO and metals, the Board concludes that none of these parameters will be changed enough to affect any water use downstream of the mine, or at the International Boundary, in either the optimal or adverse case. Although there should be no significant change in DO concentrations in the Flathead River at the International Boundary, there is a possibility that DO concentrations could be reduced to harmful levels in bull trout spawning gravels due to lowered DO concentrations in ground waters resulting from passage of ground water through waste dumps.

### Impacts on Biota.

Development of the mine could affect algae in the creeks and the river particularly if there are changes in nutrient concentrations, temperature, and sediment deposition. The Board concludes that, in the mine site area, under the optimal case, there would be a significant increase in the amount of algae growing on the streambed. The diversity of species would decrease and the type of algae would change from small, single-celled forms to larger and more visible filamentous types. The WQCSC NEL criteria for algal biomass would be more frequently exceeded locally and seasonally than at present. Under the adverse case in the mine site area these predicted changes would be similar in kind but the effects would be greater.

At the International Boundary and for some distance downstream, under the optimal case, algal concentrations would increase significantly. This increase would occur to a greater extent under the adverse case. In either case the increases would be smaller than at the mine site.

The Board concurs with the WQCC's prediction that increases in nutrient concentrations would likely cause corresponding increases in benthic biofilms, consisting primarily of periphyton, during low flow periods, and that this would occur from the mine site to an unknown point some distance downstream of the International Boundary. Whether these increases would be visible to the naked eye is not known.

There could be an increase in algal growth below the outfalls from municipal wastewater treatment plants, all of which are located downstream of the confluence of the North and Middle Fork Flathead Rivers, due to N contributions from the proposed mine and P from the outfalls.

The Board concludes that the mine would have a detrimental impact on the benthic macroinvertebrate populations within the mine site. Under the adverse case the overall impacts would be more severe than under the optimal case. The severity of this impact would vary with locality and would diminish downstream.

Some degree of impact could occur at the International Boundary: in the adverse case there would be slight to moderate effects on benthic macroinvertebrates, while under the optimal case major changes in the population structure of benthic macroinvertebrates would be unlikely. It is unlikely that there would be any detectable changes in macroinvertebrate populations downstream of the International Boundary.

There are a number of impacts associated with the development of the mine that could affect spawning and rearing habitats for bull trout and cutthroat trout in Cabin and Howell creeks. These include toxic levels of nitrogen compounds in ground water, increases in filamentous algae smothering spawning areas, increases in sediment concentrations and deposited sediments, possible reductions in dissolved oxygen, alterations to surface or groundwater flow, and changes in water

temperature. Given the BRC's interpretation of the two cases defining the mine, the Board concludes that the virtual elimination of the bull trout populations from Howell and Cabin creeks is probable. However, given the optimal and adverse cases as defined by the Board, the effects on bull trout and other fish species in Cabin and Howell creeks are less easily predicted. The Board concludes that, with regard to its two cases, reduction in populations of bull trout and other fish species will occur but that the extent of these reductions cannot now be predicted largely because of uncertainties regarding the ground-water regime in the mine area and the related problem of toxic compounds of nitrogen. The Board concludes that under its adverse case there would be significant reductions in fish populations but that under its optimal case the losses would be less.

The Board concludes that there will be some adverse effects on species closely associated with riparian habitats due to a reduction in the food base for some riparian animals. These effects may extend to the International Boundary. The Board notes that, if maintained, the 90-metre (297 ft.) wide buffer strip that is required to be maintained along the banks of Howell and Cabin creeks would provide some protection to riparian habitats within the mine site area.

### Impacts on Water Uses

Changes in water quantity, water quality, and biological resources due to the mine could have socioeconomic impacts on the State of Montana. Based on information provided in the WQQC and BRC reports, WUC concluded that the apparent impact from the construction, operation and reclamation of the proposed mine is limited to a loss of approximately 10 percent of the basin's bull trout population. The WUC cautioned, however, that the existing information was unsuitable for evaluating all impacts of the proposed mine on the waters of the Flathead River basin.

In a tabulated summary of potential impacts of the mine on socioeconomic activities in the Flathead River basin, based on the WQQC's and BRC's adverse cases, the WUC showed that non-

fishing recreation would be affected in B.C., but considered that there was insufficient information to forecast an impact on this use in Montana. WUC also showed that some degree of impact is anticipated on the special designations applied to the North Fork Flathead River: namely, the Wild and Scenic River designation; Glacier National Park, for which the centerline of the North Fork Flathead River is the western boundary; and the Biosphere Reserve designation.

As directed by the Board, WUC estimated the potential loss in economic value to the State of Montana resulting from a reduction in the numbers of bull trout available to fishermen. Its assessment was based on the BRC's adverse case, which predicts the elimination of the bull trout population that is dependent on Howell and Cabin creeks for spawning sites. The BRC also states that approximately 10 percent of the bull trout population of the Flathead River basin originates in these creeks.

Based on this analysis, the Board concludes that, from the standpoint of direct user values, the mine may cause an annual economic loss to the State of Montana of approximately \$300,000 to \$800,000 (1986 U.S. dollars) if the bull trout populations of Howell and Cabin creeks is eliminated. The Board recognizes, however, that although not quantified, losses associated with non-user values could increase the losses currently projected.

The special designations applicable to the North Fork Flathead River have been assigned by the United States Congress and by UNESCO. Their purpose has been to preserve and to protect the North Fork Flathead River. The State of Montana has provided a further element of protection to the North Fork Flathead River by classifying its waters as Class A1, the states highest water quality classification.

A literal interpretation of these designations and classifications would prohibit any activity that could impact on the water and related resources. The Board recognizes, however, that the pristine condition of the North Fork Flathead River has been compromised to some degree by historical

and ongoing activities in the basin on both sides of the International Boundary. The Board also recognizes that any additional development on either side of the International Boundary has the potential to counteract the purposes and intent of the special designations. The Board has carefully considered the potential impacts of the mine on the water uses that are associated with the special designations. It concludes that the greatest potential for adverse impact is associated with the fishery resources.

As stated above, the Board has not been able to determine the proportion of the fish population that could be lost; however, any diminution of the habitat that supports the fishery resources of the North Fork Flathead River would be contrary to the intent of the special designations. In the Board's opinion, the potential for loss of fish habitat due to the proposed mine is greater than that associated with current activities in the North Fork Flathead River basin.

The Board concludes that there is less risk to other water uses associated with the special designations such as recreation, aesthetics, and ecological integrity due to sedimentation, turbidity, nutrients, and increases in periphyton growth resulting from the proposed mine.

### **Extreme or Unusual Events**

There is an unknown, but potential, risk of failure of waste dumps, settling ponds, or the tailings pond. Such a failure could significantly affect water quality and biological resources at and downstream from the International Boundary. Depending on the magnitude and type of failure,

the effects on some aquatic systems could be long-term and possibly irreversible. The impact would be due primarily to sediment deposition and damage to aquatic and terrestrial biological resources. Such degradation would adversely affect the water uses associated with the special designations applicable to the North Fork Flathead River. While it is recognized that the probability of such events is low, the Board acknowledges that, over the life of the mine, the possibility of a failure of some feature or safeguard at the mine does exist.

### **Acknowledgments**

The Flathead River International Study Board acknowledges the considerable effort made by the members of the various technical committees, the sub-committee, and the task force. Without their contributions, in their various fields of expertise, this study would not have been possible. The Board extends its appreciation to the various provincial, state and federal agencies in both countries that contributed resources, especially their employees' time, to this investigation.

The Board acknowledges also the contributions of Dr. Chris H. Pharo, Environment Canada, and Mr. Richard M. Moy, Montana Department of Natural Resources and Conservation, who served as secretaries to their respective sections of the Board.

Finally, the Board expresses its appreciation to Dr. Chris Pharo for his contribution as author of the Board's report. Without his skill and professional approach the Board would not have completed its task.