

## Impacts of a Proposed Coal Mine in the Flathead River Basin



International Joint Commission  
Commission mixte internationale

*Cover photo:  
North Fork of the Flathead River,  
courtesy of the Montana Department  
of Fish, Wildlife and Parks.*

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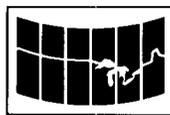
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## Introduction

In parallel letters from the Governments of the United States and Canada in December 1984 and February 1985 respectively, the International Joint Commission was requested to examine and report on the water quality and quantity of the Flathead River, with respect to the transboundary water quality and quantity implications of the proposed coal mine on Cabin Creek, a tributary of the Flathead River. Approval for the construction and operation of this mine is being sought by Sage Creek Coal Limited (the Company) from the Government of British Columbia.

The Reference from Governments pursuant to Article IX of the Boundary Waters Treaty of 1909 (the Reference) also asked the Commission to make recommendations that would assist the Governments to ensure that the provisions of Article IV of that Treaty, which state that such waters "shall not be polluted on either side to the injury of health or property on the other," are honoured. The full text of the Reference is appended (Appendix A).

To respond to the Reference, the Commission established a study board, the Flathead River International Study Board, to undertake a technical assessment as a basis for the Commission's deliberations. This Board included experts of various disciplines, and consisted of an equal number of members from the United States and Canada. It was charged initially with examining and reporting on:

- the present state of water quality and water quantity of the Flathead River at the border (including fluctuations);
- current water uses (including water dependent uses such as recreation) in the Flathead River basin together with their effects on present water quality and quantity;
- the nature, location and significance of fisheries currently dependent on the waters of the Flathead River and its tributaries, Howell and Cabin Creek;
- effects on the present state of water quality and water quantity of the Flathead River at the border which would result from the construction, operation and post-mine reclamation of the proposed Cabin Creek coal mine;
- effects on current water uses (including water dependent uses such as recreation) which would result from the identified effects on the present state of water quality and water quantity at the border; and
- effects which the construction, operation and post-mine reclamation of the proposed Cabin Creek coal mine would have on

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the habitat for fisheries in Canada in the waters of the Flathead River and its tributaries Howell and Cabin Creeks, and consequent effects on fisheries in the United States.

Subsequently, the Commission asked the Board to provide in a separate, supplementary report, information on measures that might be taken to mitigate adverse effects on fisheries and other identified adverse effects at or below the boundary, data gaps that should be filled, and other studies that are needed to assess the adverse impacts of the mine prior to further regulatory approval. Finally, the Board was asked to advise on measures that will give assurance that the proposed mine will be constructed and operated according to such requirements as would be identified.

The Board began its work in April 1985 and established a number of technical committees to assist it. After more than three years of determined work and consensus building, the Board forwarded a number of reports to the Commission:

- Flathead River International Study Board Report, 1988
- Mine Development Committee, "Proposed Sage Creek Ltd. Coal Project," 1986
- Limnology Task Force, "Report on Flathead Lake, Montana," 1986
- Water Quality and Quantity Committee Report, "Water Quality Quantity Committee Report," 1987
- Water Quality Criteria Sub-Committee, "Ambient Water Quality Criteria for Selected Variables in the Canadian Portion of the Flathead River Basin, British Columbia, Canada," 1987
- Water Uses Committee, "Water and Associated Socio-Economic Activities in the Flathead River Basin of Southeast British Columbia and Northern Montana," 1987
- Biological Resources Committee, "Predicted Impacts of the Proposed Sage Creek Coal Limited Mine on the Aquatic and Riparian Resources of the Flathead River Basin, British Columbia and Montana," 1987
- Board Supplementary Report, 1988

These reports form an important technical basis for the Commission's assessment of the matter. Considerable effort was made to describe the mine as it might be expected to exist and to assess its potential impacts under two scenarios: an "optimal" and an

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“adverse” scenario. The optimal case was developed by the Board to represent the most desirable situation believed possible with the present mine plans, whereby the mine would use state-of-the-art environmental controls and operate in compliance with all legislation and regulations. The adverse case assumed that there would be occasional failures to meet these specified requirements. The Biological Resources Committee of the Board assumed a more pessimistic scenario that stipulated regulations would not be achieved, and used that scenario as its adverse case.

The data limitations concerning this site were substantial, and much inference had to be drawn from experience with similar types of mine in the neighboring Elk River basin. While the Board was able to achieve consensus in its report drawing from the available data and professional judgement, nearly all of the Board’s conclusions are subject to varying degrees of uncertainty. Extensive additional studies would be needed to alleviate these uncertainties.

While the Board and Committee findings form much of the basis of the Commission’s conclusions, they have not been set out in detail in this report. The separate reports are available to those who wish more detail or background information.

The work of the Study Board and the Commission has also been subjected to public discussion on three occasions. At the beginning of the study, public hearings on the proposed Plan of Study were conducted at Kalispell, Montana and Fernie, British Columbia. Upon completion of the Board’s report in July 1988, public meetings were held in Cranbrook, British Columbia and Kalispell, Montana to explain the Board’s findings and the Commission’s process. The Commission returned to these areas in September for public hearings and received some fifty oral presentations. In addition, a large number of written submissions has since been received from all over North America. Only the submission of the Company explicitly supported the proposal.

The findings of the International Joint Commission, set out below, are thus based on the information placed before it from the Board reports, the public consultation procedure and its own understanding of the issues in the context of the Boundary Waters Treaty and the Reference.

## **The Current Situation**

**T**he Flathead River valley is situated in the extreme southeastern corner of British Columbia and the northwestern quadrant of Montana. In British Columbia, the Flathead valley has been logged for many years, but the water quality has remained high and the quantity essentially unaffected. While timber harvesting has been the principal land use, there has been some oil and gas exploration and prospecting, as well as recreational use of the valley.

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In the United States, the North Fork of the Flathead River flows south from British Columbia and forms the western boundary of Glacier National Park. After joining the Middle and South Forks of the Flathead, it flows into Flathead Lake, the largest natural freshwater lake in the continental United States west of the Mississippi. The national park is considered an important wilderness recreation and natural heritage area, subject to several "special" designations such as UNESCO International Biosphere Reserve status and nomination as a World Heritage Site. Several state laws and a Federal Wild & Scenic Rivers classification reflect actions to preserve the North Fork of the Flathead River in a relatively nondegraded state that helps to sustain a natural ecology.

In Montana, in addition to the recreational and preservation use categories of the park, Flathead Lake supports intensive recreational activities including cottaging, boating and fishing. The area between the park and the lake has many uses including recreational development, extensive farming, oil and gas exploration and development (under suspension), forestry operations including that of the Flathead National Forest on the west side of the North Fork, and a number of small urban centres with industrial and commercial facilities including an aluminum plant at Columbia Falls. There is a major hydro development on the South Fork (the Hungry Horse Dam) and two minor hydro installations, one influencing the level of Flathead Lake. A complete accounting of present uses is referenced on page four.

## Conclusions

The Commission generally agrees that the Board and Committee reports address the technical information that could be made available to respond to the specific questions in the Reference. Thus, the direct answers to those questions, to the extent that answers are available, are to be found in the Board's Report (the summary form of which is attached as Appendix B). The Commission's further observations and interpretations of the significance of the information available constitute the remainder of this report, along with the Commission's recommendations.

In the report of the Board, the Commission notes several points upon which there is general consensus, on the basis of available data and professional judgement, about potential impacts of the proposed mine. Included are conclusions that certain water quantity measures would not be affected at and below the boundary, under either scenario, that total dissolved solids and acidity would not change so as to affect any uses south of the boundary, that there would be no significant change in dissolved oxygen and temperature levels at the boundary and that, even under the adverse case, the mine would not contribute measurably to eutrophication of Flathead Lake

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(one of the important initial concerns). On the other hand, various Committee reports state that there would be marked increases in total suspended solids (sediments), nontoxic nitrogen compounds and to a lesser degree phosphorous reaching the international boundary. While the Board itself appears to diminish the significance of these levels, they do represent increases above the levels considered in the United States to be acceptable for the uses concerned.

Despite the amount of study that has occurred there remain throughout the reports of the Board and its Committees a number of important points where uncertainty still exists. Most notable are the concerns about groundwater flows between the mine site and the creeks, with concomitant concern about toxic levels of nitrogen compounds, temperature changes and dissolved oxygen levels. There is insufficient information about whether metals are likely to cause a problem. These uncertainties stem from two categories of the unknown: the final design of the mine including, for example, the location and/or design of drainage ditches and holding areas, and the pathways and levels of environmental effects on the ecosystem, even if such design factors were known. The Board identified several areas in its Supplementary Report where additional data are required before effects of the mine can be further analyzed.

Even if these uncertainties or the concerns arising from them could be eased with further data, it is not apparent to the Commission that they would be sufficiently alleviated. Further, there are other uncertainties that can never be totally set aside. In this regard, the Commission is particularly cognizant of the conclusion of the Board that there is an unknown but potential risk of extreme or unusual events such as the failure of waste dumps and settling ponds. While these and similar "catastrophic" events are always possible with any development, the acceptability of even a low probability or risk must take into account past experience, calculated probabilities and the nature of the values at risk.

One critical aspect of the location of the proposed mine is that it rests astride two streams that form a significant component of the remaining available spawning and rearing habitat for prime game fish in the Flathead basin — the bull trout (also known as Dolly Varden char) and to a less critical degree western cut-throat trout and mountain whitefish. Available evidence indicates that Howell and Cabin Creeks represent up to 10 percent of the habitat remaining in the system (which the Biological Resources Committee has translated into approximately 10 percent of the Flathead River basin bull trout population) and a much higher proportion of the spawning area for the fish found in the North Fork of the river. Understanding fully the degree of impact on fish populations is dependent on further data concerning the inflows and outflows of groundwater and associated chemical and physical pollutants between the stream bed and the mine site, and on measures taken to protect the stream habitat and/or mitigate for productive habitat loss.

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It is the position of the mine proponent, in its submission to the Commission dated October 27, 1988, that available evidence does not support a conclusion that the mine would endanger fish populations due to nitrogen toxicity. The Board itself stressed that the state of detailed knowledge of groundwater movement in this area is not such as to prove a groundwater contamination connection between the mine site and the fish habitat. However, consideration of the Board's report in its entirety and the reports of the technical committees, balanced by a careful consideration of what is said in the proponent's submission, leads the Commission to conclude that the likelihood of a connection exists at least on the balance of probabilities and that the most recently available data were taken into account in predicting the levels of nitrogen compounds. Further, in this context, there is the strong probability that, after a certain stage in the mine development, groundwater flow will be reversed and there will be drainage from the creeks into the pits. Not only would this undoubtedly have the deleterious effect foreseen for the eggs and fry in the spawning ground and habitat, but also it would undoubtedly act as an impediment to the adult fish in reaching and/or using those altered grounds.

The Commission emphasizes that it does not rest its conclusion as to the harmful effects on the fish solely on the anticipated results of the liberation of toxic substances. Rather the conclusion is based on the overwhelming evidence, as contained in the Board's report and backed up by the work of the technical committees, that a significant loss of fish population will occur as the result of a combination of the adverse effects of one or more of the predicted changes and not solely because of the increased level of toxic substances. These other impacts would include increased sedimentation, temperature change, flow modification, degradation of habitat, dissolved oxygen reductions, increased dissolved solids and others.

Based on these considerations and on a review of the submissions made to it, the Commission concludes that damage will inevitably occur to this habitat which would be located in the midst of a major mining development, and consequently to the fishery dependent on that habitat. Furthermore, such losses would be such as to cause a reduction in the quantity and quality of the sport fishing activity in the United States and create a negative impact on the associated economic infrastructure since the affected fish populations migrate for much of their adult lives to United States waters.

Article IV of the Boundary Waters Treaty states that waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other. In this case, and as noted above, it is not the pollution which crosses the boundary, but rather that the pollution on one side will cause a loss to the fishery, a loss which is felt on the other side of the boundary. The Commission notes that Article IV does not require that the pollution itself cross the boundary, but rather that water which crosses the boundary shall not be polluted in one country to the injury of property on the other side.

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With respect to the present proposal, the pollution expected to cause these consequences to the fishery would thus clearly constitute a breach of Article IV. In this context, it should also be noted that it has not been demonstrated that effective mitigation of that impact is feasible, if indeed it is even possible.

This conclusion is not based on the dollar losses calculated by the Water Uses Committee, although the Commission is satisfied that there will be demonstrable and sustained economic loss to a number of interests dependent on this fishery. Far more important, the Commission feels, and conclusive in this regard, is the integrity of the fishery itself. While the fishery is in the public domain, that fact does not render it any less a property. A reduction of the fish population to the extent and of the duration involved here would undoubtedly be an injury of most serious consequence to the integrity of the fishery itself, and thus to that property interest in the public domain on the other side of the border.

It should be noted that there are far-reaching implications of this Article IV principle as applied to an important migratory fishery that moves in both directions to spend part of its life cycle in each country. In such cases, there is a mutual obligation to protect that fishery by a range of management practices in both countries which will ensure that the provisions of the Treaty will be jointly honoured.

The Commission believes that, to ensure that the provisions of the Boundary Waters Treaty are honoured, when any proposed development project has been shown to create an identified risk of a transboundary impact in contravention of Article IV, existence of that risk should be sufficient to prevent the development from proceeding. This principle should apply, even though the degree of the risk cannot be measured with certainty, unless and until it is agreed that such an impact - or the risk of it occurring - is acceptable to both parties. Having in mind the risks referred to in the preceding passages of this report and the sensitivity of the uses downstream to environmental changes, the Commission considers that the Cabin Creek coal mine proposal is such a case. This, together with the damage to the fishery which the Commission concludes would occur as a result of the elimination of the spawning ground previously referred to, constitute the basis for the recommendations.

The Commission observes that the application of the Treaty may involve cases where one country has adopted uses with particularly stringent environmental requirements in a boundary region on a unilateral basis that could preclude the otherwise legitimate development opportunities in the other. It may be desirable in such cases, including this case, to consider some bilateral process for identifying and assisting in creative, alternative-development opportunities that are both sustainable and consistent with maintaining the aforementioned environmental requirements pertinent to Article IV, while paying due regard to the legitimate goals of the other country. It should also be expected that the country invoking a higher standard

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take every possible measure to maintain that standard in its own territory. Such an approach would further the overall Treaty objective of preventing and resolving disputes along the common boundary.

An example of such a creative approach is represented by the British Columbia - Seattle Agreement of March 30, 1984, an Agreement which ended a 40-year dispute over a shared international resource, the Skagit River. One section of that Agreement made provision for the creation of an Environmental Endowment Commission to administer the provision and maintenance of environmental amenities and recreation facilities in both the United States and Canadian portions of the Skagit Valley.

The creation and operation of the Skagit Environmental Endowment Commission have led to a substantially increased level of cooperation between the City of Seattle, the Province of British Columbia and the associated federal, state and provincial agencies. It has also served as a catalyst for intra-jurisdictional and binational cooperation that did not previously exist. More than one million dollars has been dispersed for a number of jointly approved projects such as studies of migratory fish and the grizzly bear, the enhancement of existing and historical trails, and the construction of a new trail which is accessible to the handicapped. The Commission sees the potential for application of a similar concept in relation to future coordinated use of the upper Flathead River drainage basin.

Indeed, in a submission to the United States Department of State titled "A Prospectus for a Conservation Reserve Initiative (CRI)," the Governor of Montana has proposed the establishment of an International Conservation Reserve to undertake in the upper portion of the Flathead River basin (North Fork, above Columbia Falls), tasks similar to those of the Skagit Environmental Endowment Commission. The main objective of the CRI is "to address the conservation agenda of both nations in conjunction with current uses in the drainage area, uses such as recreation, logging, and natural gas exploration." The Governor suggests that the upper portion of the Flathead River basin is well suited for research and the development of applied technologies which could lead to the identification of opportunities in resource management and conservation in such areas as migratory fisheries, endangered species, wildlife management programs, timber utilization, and oil and gas potential.

Mindful that the broad purpose of the Boundary Waters Treaty to settle and prevent disputes can make possible the identification and formulation of creative, binational approaches beyond the specific provisions of the Treaty, the Commission encourages Governments to consider an undertaking such as those contained within the Skagit Environmental Endowment Fund and the proposed International Conservation Reserve. The principles upon which such creative structures are based — binational studies, fact finding and planning, and mutually acceptable use of resources — are, the Commission concludes, worthy of pursuit.

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## Recommendations

The Commission recommends that, in order that Governments can ensure that the provisions of Article IV of the Boundary Waters Treaty are honoured in the matter of the proposed coal mine at Cabin Creek in British Columbia:

- (1) the mine proposal as presently defined and understood not be approved;
- (2) the mine proposal not receive regulatory approval in the future unless and until it can be demonstrated that:
  - (a) the potential transboundary impacts identified in the report of the Flathead River International Study Board have been determined with reasonable certainty and would constitute a level of risk acceptable to both Governments; and,
  - (b) the potential impacts on the sport fish populations and habitat in the Flathead River system would not occur or could be fully mitigated in an effective and assured manner; and,
- (3) the Governments consider, with the appropriate jurisdictions, opportunities for defining and implementing compatible, equitable and sustainable development activities and management strategies in the upper Flathead River basin.

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Signed this 15th day of December, 1988 at Washington, D.C.



Robert C. McEwen  
Co-chairman

P.-André Bissonnette  
Co-chairman



L. Keith Bulen  
Commissioner



E. Davie Fulton  
Commissioner



Donald L. Totten  
Commissioner



Robert S.K. Welch  
Commissioner

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**Appendix A**

Letter of Reference

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I have the honour to inform you that the Governments of Canada and the United States have agreed, pursuant to Article IX of the Boundary Waters Treaty of 1909, to request the International Joint Commission to examine into and report upon the water quality and quantity of the Flathead River, relating to the transboundary water quality and quantity implications of the proposed coal mine development on Cabin Creek in British Columbia near its confluence with the Flathead River, and to make recommendations which would assist Governments in ensuring that the provisions of Article IV of the said treaty are honoured.

For the information of the Commission, the Governments further note that on February 21, 1984, the Government of British Columbia announced that approval-in-principle had been granted to Sage Creek Limited for the proposed coal mine, thereby allowing the company to proceed with securing licenses, permits and final approvals under the provincial coal development review process. In granting this approval, the British Columbia Government acknowledged that the approval-in-principle is subject to action taken by federal authorities pursuant to their international obligations under the Boundary Waters Treaty.

In light of the above, the Governments request that the Commission examine into and report upon the following matters regarding the Flathead River Basin:

1. The present state of water quality and quantity at the border (including fluctuations) and the current water uses (including water dependent uses such as recreation) in the Flathead River Basin;
2. The nature, location and significance of fisheries currently dependent on the waters of the Flathead River and its tributaries, Howell and Cabin Creeks;
3. The effects on present water quality and quantity at the border and consequent effects on current water uses (including water dependent uses such as recreation) which would result from the construction, operation and post-mine reclamation of the proposed Cabin Creek Coal Mine; and
4. Such other matters as the Commission may deem appropriate and relevant to water quality and quantity at the border (including downstream effects in the United States) as occasioned by the proposed Cabin Creek Coal Mine.

In the conduct of its investigation and the preparation of its report, the Commission shall make full use of information and technical data heretofore available or which may become available in

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either country during the course of its investigations. In addition, the Commission shall utilize the services of specially qualified persons and other resources in Canada and the United States. The Commission shall develop, as early as practicable, a work program under this reference for the information of Governments.

The Governments request that the Commission proceed with the activities under this reference as expeditiously as practicable and report to Governments no later than 18 months from this date. The Commission should issue interim reports as appropriate.

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*Text of letters sent to the Secretaries of the International Joint Commission by James Medas, United States Deputy Assistant Secretary of State and the Right Honourable Joe Clark, Secretary of State for External Affairs of Canada, on December 19, 1984 and February 15, 1985, respectively.*

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## **Appendix B**

Report of the Flathead River  
International Study Board  
Summary and Conclusions

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## 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 centreline 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 quality 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 subcommittee, 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 Subcommittee (WQCSC), and the Limnology Task Force (LTF).

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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 licences 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 judgement 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.

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## Conclusions

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.

### Water Quantity

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 groundwater 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 groundwater 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 sediment yields from the mine site. Little information exists to quantify sediment yields from nonpoint 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

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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 temperatures 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  $-1^{\circ}\text{C}$  and  $+1^{\circ}\text{C}$  ( $-1.8^{\circ}\text{F}$  and  $+1.8^{\circ}\text{F}$ ). Under the adverse operating case temperature changes of  $-2^{\circ}\text{C}$  to  $+3^{\circ}\text{C}$  ( $-3.6^{\circ}\text{F}$  to  $+5.4^{\circ}\text{F}$ ) are possible depending on the amount of groundwater 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  $\pm 1^{\circ}\text{C}$  ( $\pm 1.8^{\circ}\text{F}$ ) 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

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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 nitrite 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 (TDS), 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 groundwaters 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.

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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 WQQC'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 groundwater, 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 groundwater regime in the mine area and the related problem of toxic compounds of nitrogen. The Board concludes that

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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 socio-economic 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 socio-economic 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 centreline 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 are 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

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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 A-1, 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.



