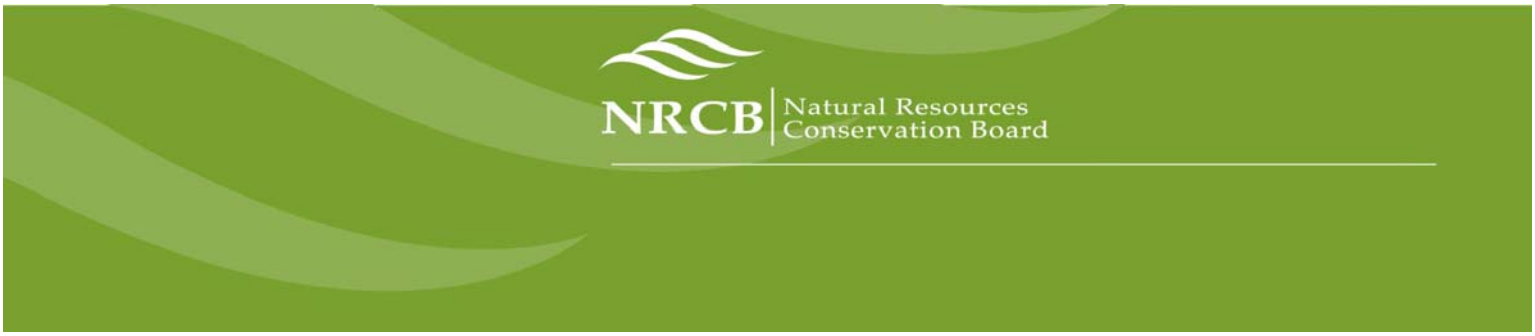

BOARD DECISION NR 2008-01

NRCB Application No. 0603

Alberta Environment and Alberta Infrastructure and Transportation

Revised Highwood Diversion Plan

April 2008

TABLE OF CONTENTS

SECTION 1: INTRODUCTION

1.1: The Application

This report contains the decision and recommendations of the Natural Resources Conservation Board (NRCB or the Board) respecting application #0603 submitted by Alberta Environment and Alberta Infrastructure and Transportation in December 2006 for the *Revised Highwood Diversion Plan*.

This NRCB review process was initiated by a letter dated December 12, 2006 (Appendix B) to the NRCB signed by three senior Government of Alberta officials: Jay Litke, Director, Southern Region, Alberta Environment; Denis Magowan, Director, Water Management Operations, Alberta Environment; and Ron Middleton, Director, Environmental Management Services, Alberta Infrastructure and Transportation. Enclosed with the letter was the *Highwood Diversion Plan, November 2006*. Also enclosed were:

1. Two-volume *Report and Recommendations for Highwood Diversion Plan* submitted by the Highwood River Public Advisory Committee; and
2. *Alberta Environment Response to the Recommendations of the Highwood Public Advisory Committee for the Highwood Diversion Plan*, December 4, 2006.

While the December 12, 2006 letter and attachments submitted by the Government of Alberta (the current application) do not follow the usual form of an application to the Natural Resources Conservation Board and do not meet all of the technical requirements for an application set out in the *Rules of Practice of the Natural Resources Conservation Board Regulation*[1], it is the Board's view that the information provided is sufficient to enable it to meet its statutory decision-making responsibilities.

The Board's jurisdiction to consider this application arose from the Report of the NRCB/CEAA Joint Review Panel, May 1998, concerning Application #9601, submitted by Alberta Public Works, Supply and Services (APWSS) for the *Little Bow Project/Highwood Diversion Plan* (the original application). The 1998 NRCB/CEAA Decision Report deferred its decision on two important matters: one, the operating plan for the expanded works for the water diversion in the low flow summer season and two, consideration of the expansion of the Women's Coulee Reservoir. As the current application does not request approval for additional storage in the Women's Coulee Reservoir, the focus of this Decision Report is necessarily limited to the water diversion plan. The Board's ongoing role and continuing jurisdiction to consider this application are described below in Sections 2 and 3.

The current application is described in detail in this Decision Report.

[1] A.R. 77/2005.

1.2: Additional Information

In support of the application, the Board requested the report: *Highwood River IFN, Instream Flow Needs, Technical Working Group Final Report.*[2] Received December 18, 2007, this report completed the Board's information requirements.

1.3: Role of the Federal Government in the Review Process

The NRCB/CEAA Joint Review Panel which heard the original application for the *Little Bow Project/Highwood Diversion Plan* consisted of panel members appointed as a division of the NRCB under the *Natural Resources Conservation Board Act* (*NRCBA*)[3] and as a *Canadian Environmental Assessment Act*[4] (*CEAA*) review panel. Each member was appointed to the division of the NRCB under the *NRCBA* and to the review panel established by the Minister of the Environment under the *CEAA*. (The original Panel is referred to throughout this Decision Report as the "Joint Review Panel" to distinguish it from the current Board Panel.)

The Canadian Environmental Assessment Agency is not a participant in the current review. By letter to the NRCB dated May 17, 2007 (Appendix C), Jean-Claude Bouchard, President of the Canadian Environmental Assessment Agency, indicated that since no federal authority has any power to exercise or duty or function to perform regarding the subject matter of the current application, being the revised diversion plan for the low flow season, there was no need to appoint a joint review panel.

1.4: Public Notification

A notice informing members of the public of the availability of the current application for review and comment was published on June 26, 2007 in the *Calgary Herald, Nanton News* and *Okotoks Wheel* and on June 29, 2007, in the *High River Times*. Interested parties with concerns or objections were invited to file a written submission with the NRCB no later than July 31, 2007. Readers of the notice were also informed that the NRCB could reach its decision without holding a public hearing if it did not receive any objections to the application.

On June 26, 2007, a division of the Board was established to determine the current application. This division (referred to as the Board or Panel) consists of Vern Hartwell (panel chair), Gordon Atkins, Jim Turner and Donna Tingley.

As the NRCB did not receive any objections to the current application, the Panel decided to proceed to a decision without holding a public hearing.

[2] Alberta Transportation, 2002.
[3] R.S.A. 2000, c. N-3.
[4] S.C. 1992, c. 37.

SECTION 2: BACKGROUND TO THE CURRENT APPLICATION

2.1: NRCB/CEAA Joint Review Panel

2.1.1: Introduction

As the current application represents a continuation of the original 1996 application to the NRCB for the *Little Bow Project/Highwood Diversion Plan*, the following information describing the original application, 1998 NRCB/CEAA decision and subsequent meetings gives historical perspective and provides a necessary transition to the current application.

2.1.2: The Original Panel

The Joint Review Panel appointed to consider the original APWSS Application for the *Little Bow Project/Highwood Diversion Plan* (the Joint Review Panel) was established under both the *Alberta Natural Resources Conservation Board Act* (*NRCBA*) and the federal *Canadian Environmental Assessment Act* (*CEAA*).

The NRCB is formed pursuant to the *NRCBA* to:

> *"provide for an impartial process to review projects that will or may affect the natural resources of Alberta in order to determine whether, in the Board's opinion, the projects are in the public interest, having regard to the social and economic effects of the projects and the effect of the projects on the environment."*

The *NRCBA* determines which natural resource projects trigger an NRCB review. Under the Act, reviewable projects include "water management projects" which are defined as projects to construct a dam, reservoir or barrier to store water or a water diversion structure or canal for which an environmental impact assessment has been ordered. Regulations under the *Alberta Environmental Protection and Enhancement Act*[5] *(EPEA)* further define water management projects as projects involving construction of a dam over 15 m high or a canal or diversion capable of conveying more than 15 m^3 of water per second.[6] The original application fell under the purview of the *NRCBA* as the dam heights for the Little Bow River Reservoir and the expanded Women's Coulee[7] Reservoir each exceeded 15 m.

The federal environmental assessment process is established under the *CEAA*. An environmental assessment is required under the *CEAA* where a federal authority:

- is the proponent of the project;
- makes a financial commitment to enable the project to be carried out;
- administers federal lands and provides for their use for the project; or
- issues a permit, license or approval under specified legislation to the project.

[5] R.S.A. 2000, c. E-12.
[6] At the time of the original application, this specification was found in the *NRCBA.*
[7] Referred to as "*Squaw Coulee*" in the original application and Board Decision Report.

Under the *CEAA*, Fisheries and Oceans Canada assumed the role of Responsible Authority and initiated a comprehensive study of the proposed project. While the comprehensive study was in progress, on January 10, 1997, the Minister of Fisheries and Oceans referred the proposal to the Federal Minister of the Environment for a public review by an environmental assessment panel pursuant to section 21(b) of the *CEAA*. When making this request for a panel review, the Minister of Fisheries and Oceans noted concerns about potential environmental effects and effects on lands and traditional values of First Nations.

The Minister of Fisheries and Oceans further requested that the Minister of Environment enter into a joint public review of the project with the NRCB. On March 14, 1997, the NRCB and the Canadian Environmental Assessment Agency (the Agency) entered into an agreement for the operation of a Joint Review Panel for the Little Bow Project/Highwood Diversion Plan Water Management Project. The agreement covered the constitution of the Panel, cost-sharing arrangements and the conduct of the proceedings, as well as other administrative issues related to the operation of the review. A joint Panel consisting of Ken Smith (Chair), George Kupfer and Susan Nelson (the Joint Review Panel) was established to review the Little Bow Project/Highwood Diversion. The Joint Review Panel acted as a division of the NRCB under the *NRCBA* and as a *CEAA* review panel and each member was appointed to the division of the NRCB under the *NRCBA* and to the review panel established by the Minister of the Environment under the *CEAA*.

2.1.3: The Original Application

The original application to the NRCB and the Department of Fisheries and Oceans affected the Highwood and Little Bow river basins in southern Alberta and was developed to resolve a number of outstanding problems:

- *"reduce diversions from the Highwood River during critical summer periods improving water quality and instream flows to benefit fish and recreation in the lower Highwood River;*
- *secure water supplies for Vulcan, Carmangay, Nanton, Cayley and three rural water cooperatives;*
- *give Champion an alternative or second water source which would provide a year round supply and lower pumping costs;*
- *reduce turbidity in the raw water supply for Vulcan, Carmangay and three water cooperatives and reduce water treatment costs;*
- *improve domestic and stock water supply for users along Mosquito Creek, the Little Bow River and around Clear Lake;*
- *secure water supplies for 4,660 ha (11,500 acres) of existing irrigated farming and for 8,100 ha (20,000 acres) of additional irrigation; and*

- *restore and stabilize levels in Clear Lake and nearby wetlands for recreation, fish and wildlife habitat."*[8]

The Little Bow Project consisted of three components:

1. Little Bow Canal – The capacity of the existing diversion and canal through the Town of High River was to be tripled from 2.8 m^3/s (100cfs) to 8.5 m^3/s (300 cfs) to allow more water to be diverted from the Highwood River during high flow periods.

2. Little Bow River Dam and Reservoir – This dam was to be a 25 m (82 foot) high earthen structure with a concrete spillway, located approximately 20 kilometres (12 miles) west of Champion in the Municipal District of Willow Creek No. 26 and in the County of Vulcan No. 2. It was planned to create a reservoir that would cover 835 ha (2,060 acres) and hold 61,700 dam^3 (50,000 acre feet) of water and it was to be filled from the natural runoff in the Little Bow River basin and water diverted from the Highwood River.

3. Clear Lake Diversion – This diversion was to consist of a diversion structure on Mosquito Creek with a 10 km (6 mile) canal to Clear Lake which would allow the lake and 12 wetlands along the canal route to be filled when flows in Mosquito Creek were high. It was to be located approximately 15 km (9 miles) east of the Town of Stavely in the Municipal District of Willow Creek.

The original proposed project is illustrated in Map 1.

[8] Alberta Public Works, Supply and Services, *Proposed Little Bow Project/Highwood Diversion Plan, Environmental Impact Assessment.* Volume 1, Summary Report 1995, p.3.

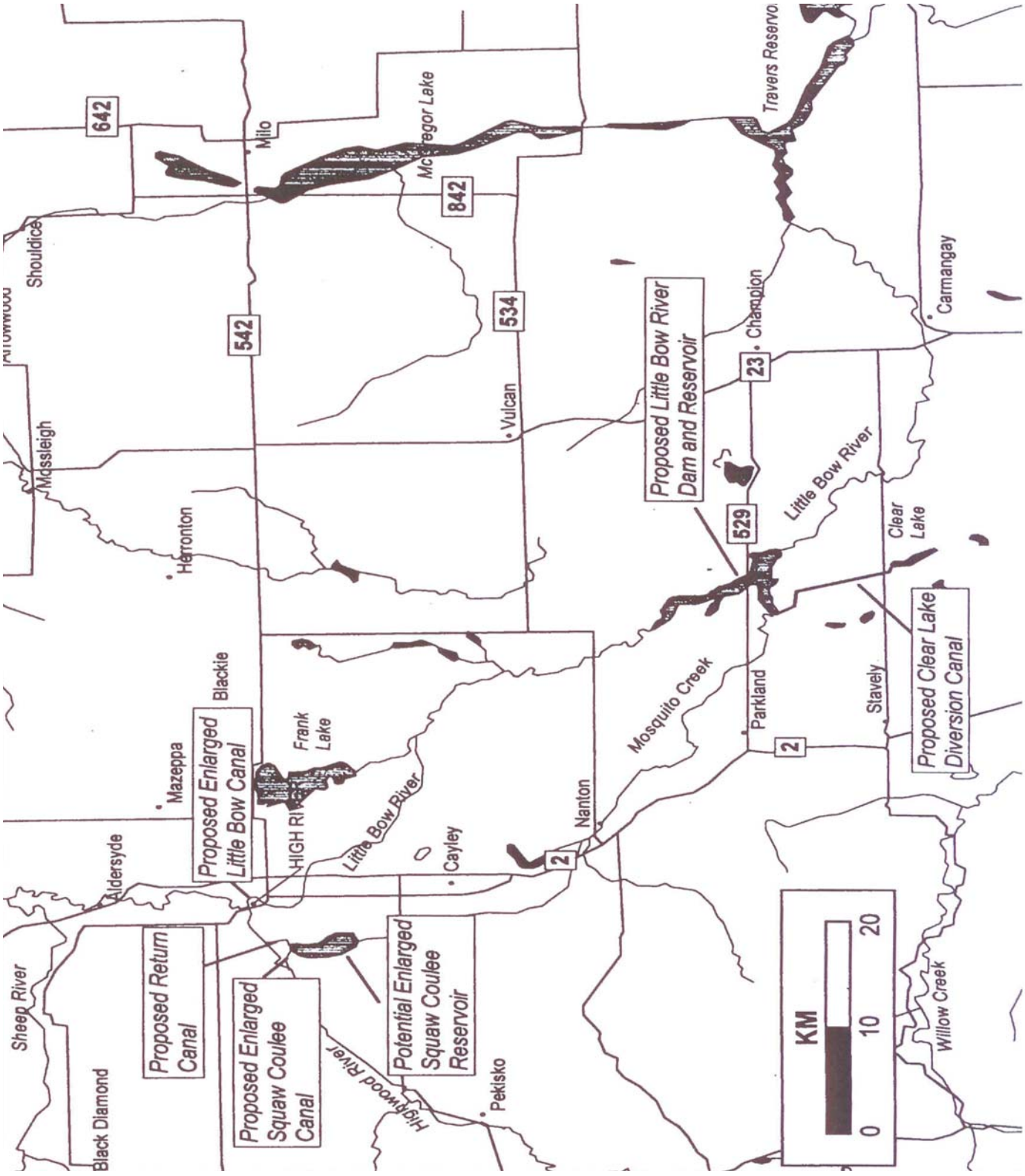

Figure 1: Little Bow Project Highwood Diversion Plan

The proposed Highwood Diversion Plan was the operating plan for the three structures included in the Little Bow Project plus the existing Women's Coulee Diversion and was based on an assessment of the flows required to protect the aquatic resources of the Highwood River.

For the proposed enlarged Little Bow Canal, a flow of 0.57 m^3/s (20 cfs) would be diverted in the winter months and throughout the rest of the year, the minimum diversion would be reduced to 0.28 m^3/s (10 cfs) with a maximum of 8.5 m^3/s (300 cfs) subject to meeting the instream flow requirements in the Highwood River. Diversions greater than 0.28 m^3/s (10 cfs) would commence with spring runoff on the Highwood River, normally in early May, and cease by late July.

For the Little Bow River Reservoir, operations would vary significantly from year to year in response to flow conditions and water demands; however, in most years the reservoir would fill by mid-May. The reservoir would remain full throughout June and levels would gradually start to drop until late September. In about half the years, drawdown would be less than 3 m (10 feet), and in over 80 per cent of the years, it would be less than 5 m (16 feet). A succession of dry years, similar to those of the 1980s, would result in drawdowns of as much as 14 m (45.5 feet) and there would be years when the reservoir would not completely fill.

The Clear Lake Diversion would be operated from mid-April to mid-September when water would be diverted, if available, to bring Clear Lake to its full supply level and offset withdrawals and evaporation. Maximum diversion from Mosquito Creek would be 1.7 m^3/s (60 cfs), but rates would normally be lower. Clear Lake would normally fill by late May and remain full through June and into July, with levels generally dropping gradually until mid-September. In approximately 75 per cent of the years, the drawdown would be less than 1 m (3.3 feet) and would never exceed 2 m (6.6 feet).

For the existing Women's Coulee Reservoir, there would be no diversion from the Highwood River from early October to the end of April. The minimum diversion throughout the summer would be 0.28 m^3/s (10 cfs). The maximum would be 1.20 m^3/s (60cfs) and would be subject to meeting the Highwood River Instream Flow Needs. The pattern of diversion at Women's Coulee would be similar to that of the Little Bow Canal where diversion would start in early May and, apart from maintenance of minimum diversions, would generally end in July.

Because of concerns over the failure to meet Highwood River Instream Flow Needs, an expansion to the Little Bow Project/Highwood Diversion Plan which would involve enlarging the existing Women's Coulee Reservoir and constructing a new canal from the reservoir to the Highwood River was provided for review and assessment, although it was not the intention of the applicant to build the expanded project. The applicant's request to the Joint Review Panel was set out in a May 7, 1996 letter to the NRCB:

> *"The proponent believes that the Little Bow Project is in the public interest and seeks an approval of the Board in relation to same. APWSS does not currently propose to build the enlarged [Women's] Coulee component but believes that the Expanded Project which includes the Little Bow Project and the [Women's]*

> *Coulee component may be in the public interest. Consequently, APWSS seeks further Board approval for the Expanded Project. If the Board finds that the Little Bow Project and the Expanded Project are both in the public interest, the proponent seeks a Board recommendation as to which project is preferable with reasons."*[9]

The Diversion Plan would also be modified. An enlarged Women's Coulee Reservoir would permit storage of additional Highwood River water during high flow periods. It would eliminate the need to divert water into Women's Coulee during low flow periods; also water would be returned to the Highwood River to offset diversions into the Little Bow Canal.

The enlargement of the Women's Coulee Reservoir would require the construction of two new earthen dams with associated control structures to expand reservoir storage from 360 dam^3 (293 acre feet) to 6380 dam^3 (5,175 acre feet). There would be a concrete emergency spillway at the south dam. The existing Women's Coulee Diversion Canal would be partly rehabilitated and a new 0.66 m^3/s (23 cfs) return canal from the reservoir to the Highwood River would be built.

The main difference between the Highwood Diversion Plan and the Expanded Diversion Plan was additional diversion to the enlarged Women's Coulee Reservoir and releases back to the Highwood River. Reservoir operations would vary considerably from year to year depending on river flows and water demands. Normally, filling would start in mid-April with water being diverted from the Highwood River up to the maximum 1.7 m^3/s (60 cfs), depending on the Highwood River Instream Flow Needs. The reservoir would reach full supply level by early June and reservoir levels would remain constant until late July or early August when releases would be required to meet licensed demands on Mosquito Creek or the Instream Flow Needs of the Highwood River. Reservoir levels would normally drop until late September or early October. Some refilling of the reservoir would often occur in the autumn when consumptive water demands decrease. Reservoir levels would remain relatively constant throughout the winter. Average drawdown of reservoir levels over the summer would be less than 2 m (6.6 feet), but on occasion would exceed 10 m (33 feet).

In the course of reviewing the original application, the Joint Review Panel asked that an option of further expansion of the Women's Coulee Reservoir be considered; this option became known as the Super Expanded Women's Coulee Option. The question from the Joint Review Panel was how large a reservoir could be built at that location without affecting the Women's Buffalo Jump. The Super Expanded Women's Coulee Option was a major element of the Board Order resulting from the Joint Review Panel's 1998 Decision Report and it is described in more detail in this Report.

[9] Quoted in NRCB/CEAA, *Report of the NRCB/CEAA Joint Review Panel,* Application #9601 – Alberta Public Works, Supply and Services - May 1998, p. 9-5.

2.1.4: NRCB Decision Report

The Joint Review Board held 19 days of public hearings on the Little Bow Project/Highwood Diversion Plan, between November 12, 1997 to January 9, 1998, in Vulcan and High River, Alberta. It issued its decision in May 1998.

In summary, the Joint Review Board approved, with conditions, the construction and operation of the Little Bow River Reservoir, the construction and operation of diversion works on Mosquito Creek and associated conveyance canal leading to Clear Lake, and the construction of the works at High River to divert water from the Highwood River and the enlargement of the existing canal to the Little Bow River. Operating plans for the facilities in the high flow period were approved, while consideration of the operation plans for these works during the low flow season of late July and August was deferred, pending receipt and review of additional information. Also deferred was consideration of the construction and operation of the expansion of the Women's Coulee Reservoir and associated diversion works and return works subject to receipt and review of additional information.

NRCB Board Order 9601-1, included as Appendix D, and described in detail below, outlined the specific information requirements for the deferred items and the process to be followed in acquiring that information.

Several conclusions reached by the Joint Review Board in its Decision Report are significant with respect to the deferred items listed in NRCB Board Order 9601-1. Of particular importance is the Joint Review Panel's approach to assessing the proposed diversion plans. Fundamental to this approach was its adoption of a sustainable development frame of reference to assess the proposed project, based on the following principles:

> *"First, water management projects must respect existing riparian rights and water licenses, and should not result in the loss or injury to existing water rights.*
>
> *Second, water management projects must be able to meet basic environmental criteria to avoid significant adverse effects.*
>
> *Third, water management projects must be able to meet current and future needs for domestic, riparian, and municipal needs, and other consumptive uses.*
>
> *These environmental, social and economic considerations are basic to the determination of the public interest. A project must be able to meet these three criteria to be worthy of detailed consideration by the Panel with respect to project effects."*[10]

With respect to the diversion plans, the Joint Review Panel observed that the applicant's proposed diversion plan did not meet the project's basic objectives as license commitments were not met, flows in the Little Bow River were inadequate, and the

[10] *Ibid.*, *Report of the NRCB/CEAA Joint Review Panel,* p. 8-5.

Preliminary Instream Flow Needs (IFN) for the Highwood River were not met. The expanded diversion plan was identified to alleviate predicted IFN deficits modelled in the examination of the diversion plan. Nevertheless, while the expanded diversion plan would meet the IFN minimum criteria, it would not meet the requirements of a more stringent science-based IFN.

Accordingly, the Joint Review Panel concluded that:

> *"the proposed Diversion Plan fails to remedy the current deficits and fails to meet future needs for water. It would not meet the basic criteria of sustainable development, since it would not meet existing licence commitments; it would not meet Preliminary IFN requirements; and it would not meet environmental and consumptive water quality requirements in the Little Bow basin. The proposed Expanded Diversion Plan does not meet the minimum Preliminary IFN used in the analysis. However, it also does not meet the other basic criteria of a sustainable development, since it did not contemplate meeting existing license commitments, and it does not meet ecosystem and consumptive needs due to the poor water quality associated with low conveyance flows. The Panel finds serious concern with the Diversion Plan and the Expanded Diversion Plan. The Panel concludes that the Applicant's proposed diversion plans are not sustainable and could not remedy the problems that already exist."*[11]

Further, the Joint Review Panel observed that there were very few alternatives for dealing effectively with the demand for consumptive uses of water during low flows, and it concluded that in the context of sustainable development, there was a need for storage for the Highwood basin. The Joint Review Panel concluded that the proposed diversion plans contained limitations, especially with respect to the need to meet current demands for water and there was an interest in alternative diversion plans based on the development of storage on the Highwood River. Accordingly, during the review process the original applicant produced model runs for a Super Expanded Women's Coulee Reservoir leading the Joint Review Panel to conclude that:

> *"on the basis of the information currently available to the Panel, the Super Expanded [Women's] Coulee Reservoir could meet current requirements for water in the basin and remedy the currently unsustainable over-allocation of water. The Panel tentatively concludes that the modelling currently available shows that the development of storage equivalent to the Super Expanded [Women's] Coulee Reservoir may fall short of meeting all future water needs while providing sufficient protection to the environment."*[12]

The Joint Review Panel found that there was a need to consider a continuum of storage options to meet current and future needs, with the Super Expanded Women's Coulee presenting a feasible option. However, further evidence was required before the Board would be able to draw a final conclusion. Accordingly, the original applicant was directed to update the comparative analysis of the potential storage sites including the Super

[11] *Ibid.*, p. 8-12.
[12] *Ibid*., p. 8-14.

Expanded Women's Coulee site, Tongue Creek Site 4 and Stimson Creek Site 8, and to show comparative data regarding environmental, social and economic effects. Public consultation was to be an integral part of the further analysis and assessment.

The Joint Review Panel also required that diversion plans for management of water in the Highwood River be revised to meet the basic criteria of a sound water management project, including:

- objectives that ensure that the science-based IFN is observed in the Highwood;
- existing license commitments are upheld;
- flows are maintained in both the upper Little Bow River and Lower Mosquito Creek;
- known future demands are met; and,
- consideration is given for reserving water, if possible for future unknown requirements.[13]

2.2: Board Order #9601-1

The Joint Review Panel issued Board Order #9601-1 as part of its Decision Report. It is attached to this decision report in Appendix D.

Board Order #9601-1 describes those matters deferred by the Joint Review Panel, subject to certain supplemental information being filed and reviewed. The following is a summary of the specifications and deadlines included in the Board Order divided into two categories, being those matters deferred by the Joint Review Panel and the information requirements related to the assessment of the Super Expanded Women's Coulee.

2.2.1: Deferrals

- Consideration of the operating plan for the expanded works for the diversion of water at High River from the Highwood River to the Little Bow River during the low flow season is deferred – *pending receipt and review of additional information described in the Order* (clause 1); and,
- Consideration of the expansion of the Women's Coulee Reservoir and associated diversion works and return works is deferred (clause 2).

2.2.2: Assessment of the Super Expanded Women's Coulee

- The Operator must file with the Board for its approval, the plans for the completion of the assessment of the economic, social and environmental effects of the Super Expanded Women's Coulee project component, including a specific plan for public involvement – *three months from the date of issuance of the Order* (clause 4);

[13] *Ibid*., p. 8-16.

- The Operator must complete its economic, social and environmental assessment of the effects of the Super Expanded Women's Coulee project component – *twelve months from the issuance of the Order* (clause 3);
- The completed assessment of the Super Expanded Women's Coulee Reservoir must include an update by the Operator of the comparative analysis of potential storage sites within the Highwood River Basin, including among other sites, the Super Expanded Women's Coulee site, Stimson Creek Site 8 and the Tongue Creek Site 4; comparative data regarding environmental, social and economic effects must be included for each site (clause 5);
- The operator must file with the updated assessment of the economic, social and environmental effects of the Super Expanded Women's Coulee project component, a revision of the IFN analysis used in the application, to reflect current fisheries management objectives for the Highwood River, including instream flow needs based on the most recent information regarding the River, and current scientific assessment procedures, to the satisfaction of Alberta Environmental Protection (clause 6);
- The operator must file with the completed assessment of the economic, social and environmental effects of the Super Expanded Women's Coulee project component an updated plan for the completion of the Highwood River Basin Water Management Plan (HMP) based on the advice and consent of Alberta Environmental Projection, including:
    - The design of an independent mediated/facilitated process;
    - The process to identify all stakeholders and their respective community representation;
    - Detailed timelines providing for the completion of the HMP planning process within a period of two years;
    - Cost estimates for consulting services and studies related to both the design and implementation of the HMP (clause 7).
- The completed assessment of the Super Expanded Women's Coulee Reservoir project component must include a revised Diversion Plan for the works leading to and from Women's Coulee and for diversion works downstream at High River leading to the Little Bow River (clause 8).

2.3: Public Meetings and Progress Reports

Following the issuance in May 1998 of the *Report of the NRCB/CEAA Joint Review Panel Application #9601* including Board Order #9601-1 described above, the Joint Review Panel held four public meetings wherein it provided advice and direction to those parties obliged to undertake additional work as a result of the Board Order and other interested parties. The Joint Review Panel findings and outcome of each of the four meetings was summarized and published in Joint Review Panel Reports, dated respectively: June 2000, December 2000, June 2001 and February 2002. While membership on the Joint Review Panel had changed prior to the first of the four public meetings, the Board members presiding over the public meetings are nonetheless referred to in this Decision Report as the "Joint Review Panel" to distinguish them

from the members of the current Board panel. The Joint Review Panel members who participated in the four public meetings were: Brian Bietz (chair), Carolyn Dahl Rees and Sheila Leggatt.

The four meetings and outcomes are described here in detail as they provide a necessary link between Board Order #9601-1 and the current application and provide a roadmap to the evolution of this project and its timing.

2.3.1: NRCB/CEAA Joint Review Panel – June 2000

The Joint Review Panel held a public meeting in High River on April 19, 2000 to consider an application by Alberta Infrastructure (AI) for an extension to the twelve month deadline imposed by the Board Order, also having regard to other issues raised by participants at the meeting. In its request for an extension, AI indicated that it had encountered problems with its public consultation process and that it required additional time to compile the scientific and technical studies needed to fulfill the terms of the Board Order. In its decision, the panel addressed three main issues:

1. Highwood Management Plan

   In response to concerns raised at the public meeting with respect to the relationship of Alberta Infrastructure's consideration of alternative storage sites to Alberta Environment's process to develop a Highwood Management Plan (HMP) which was to focus in Phase 1 on the assessment of alternative water management scenarios, including storage options, the Joint Review Panel considered a request to examine the full range of options as part of the HMP rather than have AI pursue the single option of off-stream storage. As well, questions were raised about the timing and sequencing of the two processes, given that AE was making good progress on the HMP while AI was requesting an extension to its twelve month deadline. Given these circumstances, the Joint Review Panel agreed that the examination of storage sites would best be conducted within the context of Phase 1 of the HMP provided it was done in a timely way, and it reached the following conclusion regarding this issue:

   > *"…the Panel believes that the public interest would be best served by having Alberta Infrastructure continue to conduct its investigations into storage sites while Phase I of the Highwood Management Plan is underway. This does not mean that the Panel is predisposed toward storage. Rather the Panel wants to ensure that if the Highwood Management Plan indicates that storage is necessary, the resulting decision-making process on a preferred storage site can be completed as soon as possible."*[14]

2. Public Consultation

   The Joint Review Panel accepted the approach agreed to by most participants whereby a central advisory/coordinating body supported by an independent facilitator (PAC) would be formed to both support AI's need for public

[14] NRCB/CEAA, *Report of the NRCB/CEAA Joint Review Panel Application #9801 – Alberta Infrastructure,* June 2000, p. 13.

consultation on storage options and the HMP process initiated by Alberta Environment.

3. Extension
   The Joint Review Panel agreed that an extension of time for further information gathering was appropriate. The schedule agreed to by the Joint Review Panel would have had the Highwood Management Plan, Phase 1 completed by Alberta Environment by March 2002 and the Alberta Infrastructure evaluation of potential storage sites completed no later than March 2002.

2.3.2: NRCB/CEAA Joint Review Panel – December 2000

The Joint Review Panel held a second public meeting in High River on November 22, 2000 at which time it was updated on AE's progress on Phase 1 of the HMP and on AI's efforts to assess the environmental, social and economic impacts of potential offstream storage sites in the Highwood basin. The Joint Review Panel observed that much of the evidence presented at the meeting focused on two issues, the HMP and the formation of the PAC, both of which were beyond the direct jurisdiction of the Joint Review Panel. Nevertheless, the Joint Review Panel made the following significant observations and findings.

1. Highwood Management Plan

   The Joint Review Panel concluded that the strategy presented by Alberta Environment and Alberta Infrastructure for completing phase 1 of the HMP, including an assessment of non-storage alternatives and an assessment of the three proposed offstream storage sites, effectively reflected the Joint Review Panel's views. In addition, the HMP would involve a PAC that would have a significant voice in determining its terms of reference and operational procedures. The role of AE and AI was to assist the PAC in an advisory capacity.

2. Public Advisory Committee (PAC)

   The Joint Review Panel expressed its support for the process proposed by AE for selecting and organizing the PAC, particularly the use of an independent facilitator, allowing groups and individuals within the basin to prescribe the structure of the PAC and allowing the PAC to develop its terms of reference and operating principles.

3. Role of Alberta Infrastructure

   While AI indicated that it planned to wait until the PAC concluded that offstream storage was a viable option before seeking landowner permission to conduct more detailed site investigations on the three optional sites listed in the Board Order, the Joint Review Panel expressed a concern that landowner permissions could be delayed and result in AI not being able to meet its March 2002 deadline. The Joint Review Panel concluded that it would be helpful if AI were to conduct a "fatal flaw" analysis on the three potential offstream storage sites before March

2001 based on its present level of knowledge, past information and the information expected from consultants conducting impact studies.

2.3.3: NRCB/CEAA Joint Review Panel – June 2001

The Joint Review Panel's third public meeting was held in High River on June 2, 2001 to address progress on Phase 1 of the HMP and meeting Board Order #9601-1, and to review Alberta Transportation's "fatal flaw" analysis of the three potential offstream storage sites.

According to the report of the Joint Review Panel, it concluded there was a need for the roles and responsibilities of the various parties to complete HMP-related work and for various aspects of Board Order #9601-1 to be clarified if the March 2002 deadline was to be met. The Joint Review Panel acknowledged that its role was not to direct the HMP which was the responsibility of AE in collaboration with the PAC. Nevertheless, as the HMP was expected to address some of the issues in the Board Order, the Joint Review Panel offered some recommendations to move the process forward to meet the March 2002 deadline.

Given the fact that time was of the essence and the PAC had made little progress with respect to the HMP, the Joint Review Panel concluded that it was necessary to separate the roles of PAC from AT and AE with respect to storage and the selection of the most appropriate site for storage.

The Joint Review Panel concluded that Alberta Transportation needed to continue its investigations of storage if the diversion plan was to be completed in a timely fashion, especially given that filling of the new Little Bow River reservoir was expected to start in 2003. It was acknowledged that while non-storage options being examined by the PAC, could play a role in addressing water demands in the basin, the Joint Review Panel saw *"no evidence that refutes the conclusion about the need for additional storage."*[15]

The Joint Review Panel's request for a "fatal flaw" analysis of the three potential storage sites generated much discussion at the meeting and caused some confusion. In response, the Panel offered the following clarification as to what was required:

> *"In suggesting a 'fatal flaw' analysis, the Panel was seeking a summary evaluation that would quickly establish the relative merits of each possible site. The Panel was not asking Alberta Transportation to identify one single factor that might preclude development at any particular site, but rather to determine whether there might be a combination of factors that would establish the inferiority or superiority of that site relative to the Women's Coulee Site."*[16]

Further, the Joint Review Panel required AT to complete its comparative analysis of the Stimson and Tongue creek sites to the Women's Coulee site within 60 days of the issuance of the Board's report. The Joint Review Panel anticipated that upon the completion of the assessment, followed by a period for public comment, it would call a

[15] NRCB/CEAA, *Report of the NRCB/CEAA Joint Review Panel Application #9801 – Alberta Transportation*, June 2001, p. 13.
[16] *Ibid.*, p. 14.

public meeting after which it would make a decision on the most appropriate site or sites for development of storage within the Highwood basin.

In its decision report, the Joint Review Panel clarified the roles of the respective parties to develop a revised diversion plan under the Board Order. The Joint Review Panel concluded that it was the responsibility of the Alberta Government to complete and submit a diversion plan as part of any application to the NRCB. Although the Alberta Government had chosen to obtain advice from the PAC on the diversion plan in the context of the HMP, its production remained a government responsibility nonetheless.

2.3.4: NRCB/CEAA Joint Review Panel – February 2002

The Joint Review Panel's fourth and final public meeting was held in Okotoks on December 1, 2001. The objectives of the meeting were to: *"review Alberta Transportation's comparative site assessment and to determine whether March 2002 still represented a reasonable deadline for completing the HMP and for fulfilling the requirements of the Board Order."*[17] While the Joint Review Panel's Report concluded with an offer to PAC to hold another public meeting if it would assist the process, no further NRCB meetings were held.

Following are the significant Board findings and decisions from the December 2001 meeting:

1. Deadline to Meet the Conditions of Board Order #9601-1

   The PAC proposed an alternative work program which would necessitate the extension of the deadline to October 31, 2002 to meet the terms of the Board Order. With the additional time, the PAC would be able to complete its work to determine whether storage was needed, including an assessment of non-storage options. There were concerns expressed to the Joint Review Panel that an extension would prolong the uncertainty for those residents in the areas where reservoir development was most likely; in light of this concern, the Joint Review Panel urged AT to start on its technical studies, and if it was determined that storage was needed, immediately proceed to seek Cabinet support for the project and start land acquisition. In the end, the Joint Review Panel agreed to extend the date to meet the terms of the Board Order to October 31, 2002.

2. Comparative Assessment of Storage Sites

   The Joint Review Panel confirmed that Alberta Transportation had met its 60 day deadline to complete a comparative evaluation of alternative storage sites in the Highwood Basin, having submitted its report titled "Highwood Basin Storage Study – Comparative Site Assessment" to the Joint Review Panel in September 2001. The Joint Review Panel noted that "*although most parties felt that the comparative assessment was not entirely complete, the majority agreed that*

[17] NRCB/CEAA, *Report of the NRCB/CEAA Joint Review Panel Application #9801 – Alberta Infrastructure*, February 2002, p.3.

additional studies would not have resulted in a different relative ranking of the three sites".[18]

The Joint Review Panel accepted AT's conclusion that the Women's Coulee site *"provides the best opportunity for the development of storage within the Highwood River basin having regard for cost and social and environmental impacts"*[19] and also concluded that the AT report fulfilled the requirements of clause 5 of Board Order #9601-1 (see Appendix D). The Joint Review Panel made this finding while acknowledging the difficulty that would be faced by AT and AE in having selected a preferred site before the need for storage had been conclusively proven.

The Joint Review Panel expressly found that the AT report did not satisfy the requirements of clause 3 of the Board Order:

> *"The Operator shall complete its economic, social, and environmental assessment of the effects of the Super Expanded [Women's] Coulee project component within twelve months of the date of issuance of this Order."*

It was expected by the Joint Review Panel that if storage were found to be needed, AT would need to prepare and submit a comprehensive assessment of the environmental, social and economic impacts of any such project as part of its application to expand storage at Women's Coulee. The Joint Review Panel also noted that clarification from Alberta Environment was needed as to whether any future application by AT for storage would trigger the need for an environmental assessment report under the *Environmental Protection and Enhancement Act*.

3. Interim Operating Plan

   AT informed the Joint Review Panel that it planned to develop an interim diversion plan for the Highwood River given the requirement that additional water was to be diverted from the Highwood River starting in the spring of 2003 to begin filling the new Little Bow River Reservoir. The Joint Review Panel accepted that the interim operating plan would be required until the revised plan was developed, in consultation with the PAC. The Panel expected to receive both plans by October 31, 2002.

SECTION 3: NRCB JURISDICTION

The current application is a continuation of the original 1996 application to the NRCB by Alberta Public Works, Supply and Services for the *Proposed Little Bow Project/Highwood Diversion Plan*. As described in 2.1: *NRCB/CEAA Joint Review Panel*, following a public hearing, the Joint Review Panel approved, subject to conditions, the construction and operation of the Little

[18] *Ibid.*, p. 23.
[19] *Ibid.*

Bow River Reservoir, the construction and operation of diversion works on Mosquito Creek and associated conveyance canal leading to Clear Lake, and the construction of the works at High River to divert water from the Highwood River and the enlargement of the existing canal to the Little Bow River. Operating plans for the facilities in the high flow period were approved.

NRCB Board Order #9601-1, included as Appendix D and summarized in 2.2 Board Order, details the specifications and deadlines applicable to the two matters deferred by the Joint Review Panel. In summary, the Joint Review Panel deferred consideration of the operating plan for the expanded works for the diversion of water at High River from the Highwood River to the Little Bow River during the low flow season and the expansion of the Women's Coulee Reservoir and the associated diversion works and return works. Board Order #9601-1 also required the Operator to complete an economic, social and environmental assessment of the Super Expanded Women's Coulee project component and to include with that assessment a comparative analysis of potential storage sites in the Highwood River Basin, an updated IFN Analysis, an updated plan for the completion of the Highwood River Basin Water Management Plan (HMP) based on the advice and consent of Alberta Environmental Projection, and a revised Diversion Plan for the works leading to and from Woman's Coulee and for diversion works downstream at High River leading to the Little Bow River. As noted earlier in this Decision Report, the Joint Review Panel found expressly that the applicant had completed the requirements in the Board Order for a comparison of potential storage sites in the Highwood River Basin (clause 5 of the Board Order).

The current Board is of the view that the items deferred by Board Order 9601-1, namely the operating plan for the Highwood Diversion in the low flow summer season and the construction and operation of the expansion of the Women's Coulee Reservoir, delimit the Board's jurisdiction and define the scope of the matters the Board can consider in making a determination on the current application. The Board acknowledges that the Board Order also included a requirement for the operator to complete an economic, social and environmental assessment of the Super Expanded Women's Coulee which was to be submitted to the Board with various other documents including an updated IFN. It is the view of the current Panel that these additional items were included in the Board Order to give direction to the applicants with respect to the information that the Board would need to complete its deliberations on the two deferred items. Those items, particularly the updated IFN and the Highwood Management Plan, were never intended to be set before the NRCB for approval as they are beyond the Board's jurisdiction. The current Board takes a similar view; information and data provided pursuant to the Board Order will be used to inform and support the current decision-making process.

Since the decision of the Joint Review Panel in 1998, considerable work has been undertaken by the PAC and the applicants, Alberta Environment and Alberta Transportation, to resolve outstanding issues and provide the NRCB with the information it needs to make a decision. It is readily apparent to the current Board, that many of the issues respecting the Highwood River are interrelated and do not necessarily conform to the strict legal requirements and jurisdiction of the NRCB and government participants in this process. In working to find a notable consensus agreement regarding the issues before them, the PAC made recommendations and drew conclusions that may be outside of the strict jurisdictional limits imposed by law on the NRCB. Nonetheless, the current Panel has studied the PAC recommendations and the Alberta Environment response to those recommendations in order to fully appreciate the application before it from the Government of Alberta and the background to that application. While the

current Panel must necessarily limit its decision to those matters deferred to it by the original Board in Board Order #9601-1, it is cognizant and appreciative of the full extent of the research, deliberation and insight provided by the PAC in its report and recommendations.

The application currently before the NRCB asks the Board to approve the proposed *Highwood Diversion Plan*, November 2006. However, the application does not seek approval for additional offstream storage on the Women's Coulee as had been expected by the Joint Review Panel in its 1998 Decision Report. The background and reasons why the applicants are not pursuing offstream storage are described fully in this Decision Report. Accordingly, while descriptive material and analysis is presented in this Decision Report concerning the need for additional offstream storage, it is beyond the jurisdiction of this Board to approve offstream storage which is not before it for approval. Nevertheless, because the work undertaken by the applicants on additional offstream storage and the revised Instream Flow Needs analysis forms the building blocks for the current application, those matters are described fully in this Decision Report and where appropriate, subject to Board comment.

SECTION 4: TECHNICAL INFORMATION REQUIRED

4.1: Instream Flow Needs Working Group

Condition No. 6 of NRCB Board Order No. 9601-1, from the NRCB/Canadian Environmental Assessment Agency Joint Review Panel hearings for the Little Bow Project/Highwood Diversion Plan, states:

> *"The Operator shall, to the satisfaction of Alberta Environmental Protection, revise the IFN analysis used in the Application to reflect current fisheries management objectives for the Highwood River and to include instream flow needs based on the most recent information regarding the River, and current scientific assessment procedures and file the results thereof in the updated assessment of the economic, social and environmental effects of the Super Expanded Woman's Coulee project component."*

A Technical Working Group convened on September 4, 1998 to:

> *"Refine the Highwood IFN using current fisheries management objectives and IFN methodologies. The product will be a recommended "science-based" habitat-flow regime for the open water period and will not include any flow compromises due to consumptive demands. Winter IFN and trade-offs between IFN flows and consumptive demands would be considered as part of the Highwood Water Management Plan (HMP) to be undertaken by Alberta Environment."*

Membership on the Working Group included experts from Alberta Transportation, Alberta Sustainable Resource Development, Department of Fisheries and Oceans Canada, and two Instream Flow Needs (IFN) consultants. The Group involved other experts as required.

In previous studies, the Highwood River was divided into five segments, based on physical characteristics, locations of tributary flows and water diversions. The original segmentation of the river (Figure 2) was reviewed by the Working Group. The Group concluded that the segmentation is still relevant; however, stated that if the project design is changed, the segmentation may need to be revisited. The Working Group focused on IFN determinations for Segments 2 and 4. An IFN recommendation was not made for Segment 1 because it is upstream of any diversions and for Segment 3 due to difficulty in data collection and hydraulic modeling associated with earlier studies. The habitat-flow relationship for Segment 5 was studied by the Working Group to ensure the IFN recommendation for Segment 4 would not affect the species in this segment.

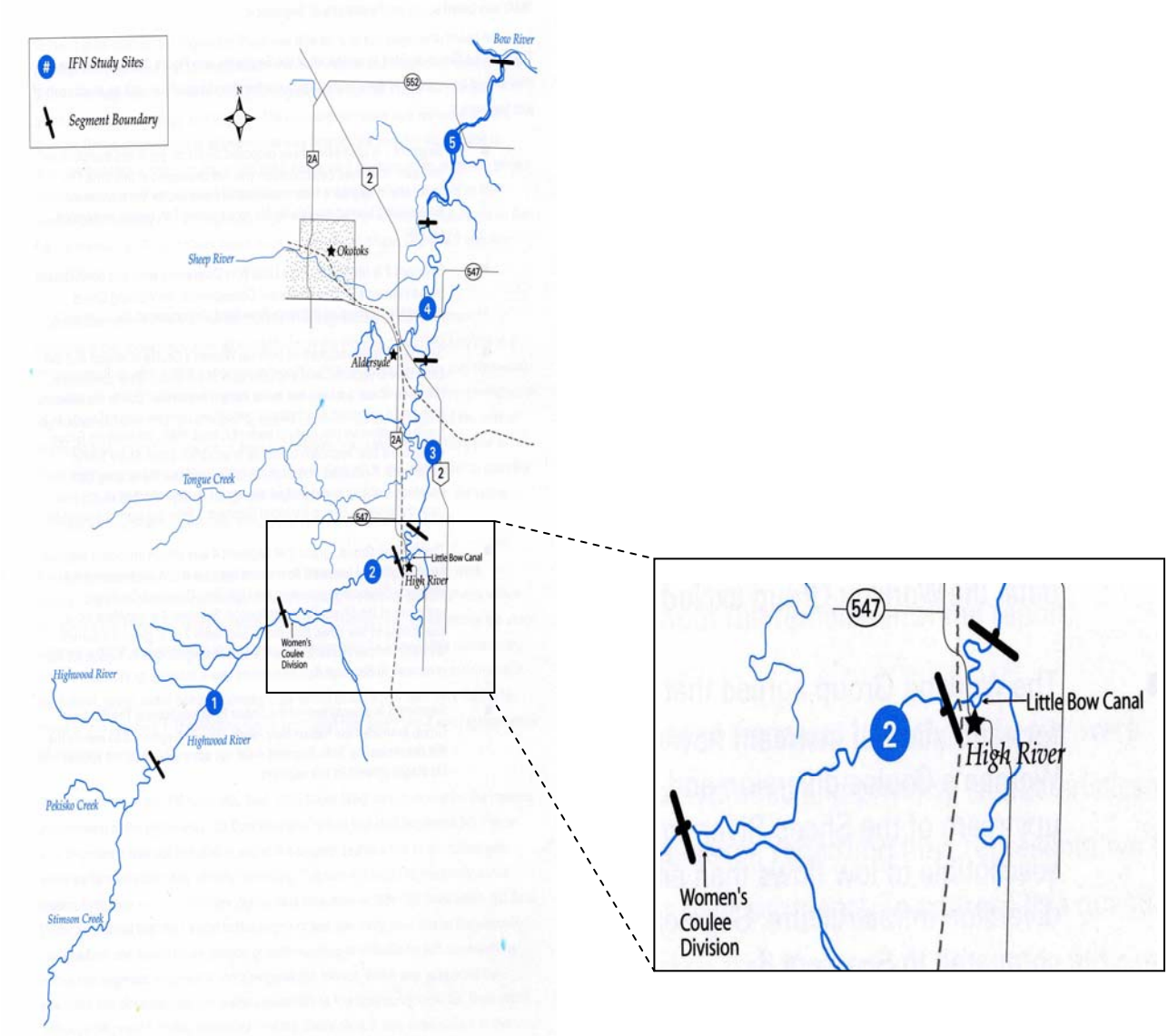

Figure 2: The Highwood River study area showing segment boundaries[20]

[20] Modified from Clipperton, et.al., 2002.

The Working Group concluded that there is no universally acceptable method for establishing instream flow requirements. The original IFN work that started in the mid-1980's was done from a relatively narrow perspective of identifying flows for selected sport fish. Since the original study, the science of IFN determination has progressed significantly. There is now a shared view among IFN scientists that maintaining intra and inter-annual variation of river flow is important for maintaining ecosystem function and native biodiversity. Maintaining flow variations is termed the "natural flow paradigm" which is widely accepted among aquatic scientists and natural resource agencies around the world. Ricter et. al. (1997) states that *"the full range of natural intra- and inter-annual variation of hydrological regimes, and associated characteristics of time, duration, frequency, and rate of change, are critical in sustaining the full native biodiversity and integrity of aquatic ecosystems."*[21] The PAC states that maintaining a similar pattern of flow variability is critical to the long-term sustainability of aquatic and associated eco-systems.

The Technical Working Group examined original IFN determination methods, including the original Fish Rule Curve approach, variations of the Fish Rule Curve approach and methods based on a time series analysis. Each method was evaluated using the following factors:

- scientific defensibility of any assumptions that were required;
- use of available site-specific information, and
- the ability to follow the natural flow paradigm principle.

The Working Group recommended an IFN (referred to as the "technical IFN") based on a time series analysis because it represented the most current science. Advantages of the time series analysis approach over previous approaches include:

- Weighted Use Average curves (i.e., the wetted area of a stream weighted by its suitability for use by aquatic organisms or recreational activity) that were used for the new IFN analysis were based on improved hydraulic calibrations and fish habitat suitability criteria.
- On-site determined magnitude and frequency for channel structure flows are met. Previous IFN determinations assumed channel structure would be provided by limitations on maximum diversion capacity.
- Comprehensive Ecosystem Base Flows are defined for every week to ensure IFN needs are met during natural low flow periods.
- The inter-annual and intra-annual flow variability is maintained which is critical to the long-term sustainability and biodiversity of the aquatic and associated eco-system.

The technical IFN recommendation of the Working Group is based on a time series analysis of scenarios that were defined as various percentage reductions of flow from weekly natural flows (Figure 3). For Segment 4, the weighted use average curves were calculated for each scenario and all life stages for Rocky Mountain Whitefish and Rainbow Trout. For Segment 2, Bull Trout juvenile and adult life stages were also considered.

[21] Ricter et. al. (1997).

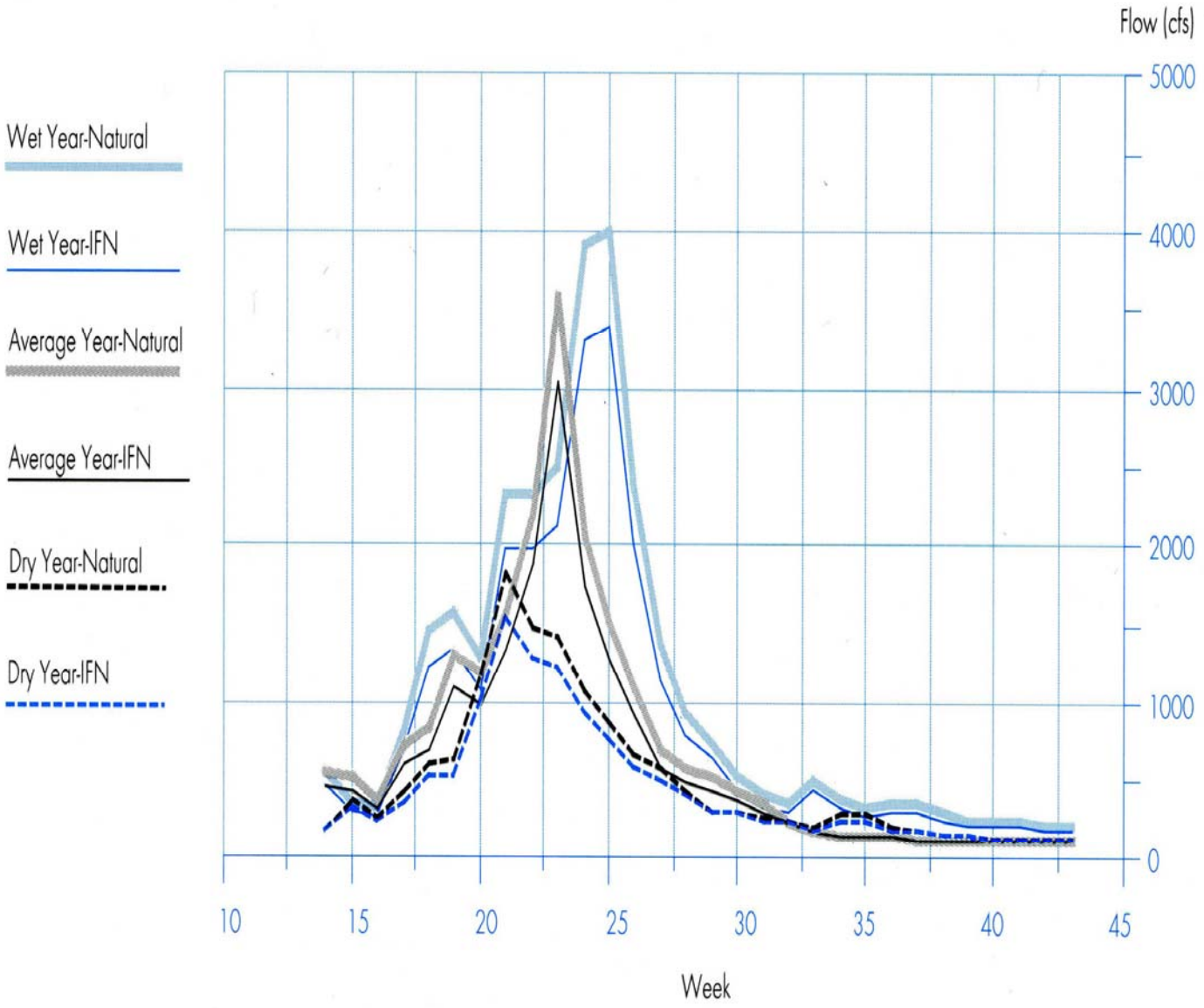

Figure 3: Example of inter-annual and intra-annual flow variability of the Working Group technical IFN for dry, average and wet flow years[22]

The following evaluation metrics were used by the Working Group to evaluate the scenarios:

- No more than a 10% reduction of the total average habitat, compared to the natural flow habitat, on an annual basis (chronic condition);
- No more than a 15% reduction in habitat compared to the natural flow on a weekly basis;

[22] Clipperton, G.K., R.F. Courtnery, T.S. Hardin, A.G.H. Locke and G.L. Walder. 2002. Highwood River Instream Flow Needs Technical Working Group Report.

- No more than a single maximum reduction in habitat of 25% compared to the natural flow for any single week in the period of record (acute condition).

Using these evaluation metrics, the Working Group made the following technical IFN recommendations:

- a 20% reduction of flow from natural for Segment 2, and,
- a 15% reduction in flow from natural for Segment 4.

The IFN recommendations have an Ecosystem Base Flow constraint which is intended to maintain habitat conditions during low natural flow periods of the Highwood. The Ecosystem Base Flow is defined as a threshold below which the instream flow requirement was all of the natural flow.

The Board concurs that there is no single method, or universally accepted way to determine IFN and acknowledges that significant progress has been made by the Technical Working Group in updating IFN requirements for the Highwood since original instream flow work was conducted on the Highwood River. A significant enhancement was the acknowledgement that providing an instream flow needs determination to protect the ecosystem should be based on the Natural Flow Paradigm which is becoming widely accepted among aquatic scientists and natural resource agencies worldwide. The Paradigm is based on evidence that inter-annual and intra-annual flow variability is vital to the long-term sustainability and biodiversity of aquatic and associated eco-systems.

4.2: Public Advisory Committee

A total of 60 scenarios were modeled and evaluated in the process of developing an Interim Diversion Plan (IDP). Considerable effort was made to minimize encroachments on the recommended technical IFN while attempting to meet the other objectives of the project.

The initial focus of the PAC was to develop an IDP that was based on meeting the objectives of the project without new storage development. This IDP was required to operate the project until storage options could be assessed. The value and effectiveness of new storage was assessed by comparing any improvements in performance with storage to the IDP. The IDP would become the Highwood Diversion Plan if the new storage was found to be ineffective.

The approach to developing the IDP was to start with a scenario that best met the technical IFN, and then to encroach on the IFN in successive iterations until consumptive uses were satisfactorily met. Encroachments on the IFN were made in a manner so as not to impact the Highwood River fishery habitat.

Eight modeling scenarios were run to explore the implications on performance of the recommended technical IFN from the Working Group. In an attempt to improve habitat performance, reduced levels of irrigation expansion in the Lower Little Bow Sub-basin were considered. Scenario IDP2.3.2 considered full irrigation expansion and the fish habitat performance that was similar to the scenario with a full technical IFN. The scenario indicated that irrigation deficits were high and frequent in the Clear Lake and Lower Little Bow expansion

blocks. Deficits of more than 100 mm (a level irrigation farmers feel is unacceptable) occurred in the Clear Lake block about 18 % of the years and in the Lower Little Bow block in about 14 percent of the years. Figure 4 illustrates that fishery performance for scenario IDP2.3.2 was better than the Base Case (i.e., representative of pre-Little Bow Project conditions [around 2001]) but fell short of the full technical IFN due to pre-Little Bow Project commitments. It should be noted that Figure 4 presents a habitat performance for adult Rocky Mountain Whitefish which have the most stringent IFN requirements. The IFN requirements for other species or other life stages of the Rocky Mountain Whitefish are less demanding.

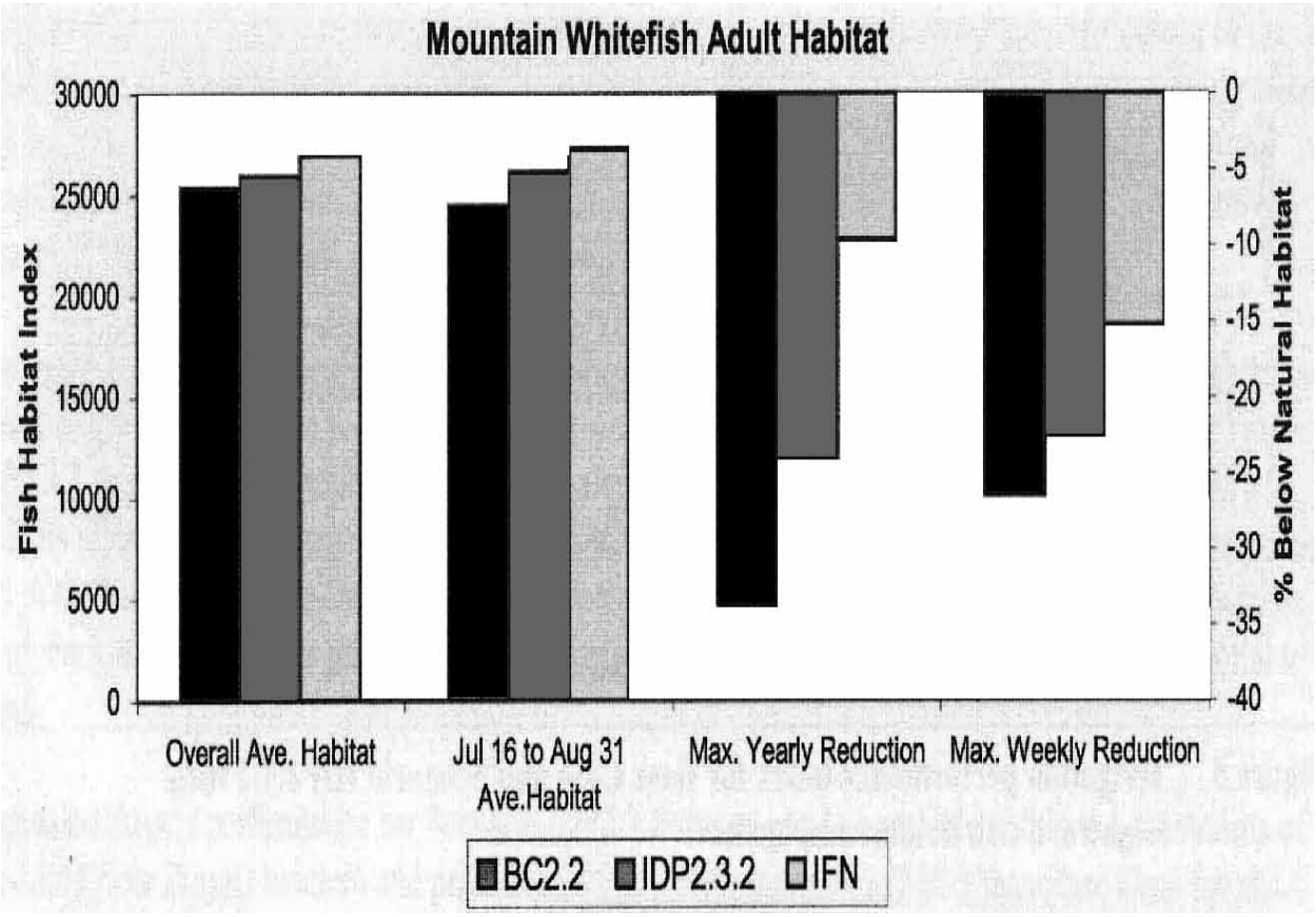

Figure 4: Fish habitat performance for Scenario IDP2.3.2[23]

Additional scenarios were run to determine the best compromise scenario that would retain fish habitat benefits (i.e., IDP2.3.2) and meet irrigation expansion requirements. Encroachments were made on IFN requirements of scenario IDP2.3.2 until it was felt any further encroachment would impact Base Case fish habitat. Scenario IDP2.5.2.3 was determined to be the best

[23] PAC Phase 1 Report, 2006, p. 36.

compromise scenario. Figure 5 indicates that the instream flow requirement for IO Rule #3 is a variation of the technical IFN recommended by the Working Group (shown as I0=Rec IN in the figure). The reduced IFN in IO Rule #3, during high flow periods is required to meet irrigation expansion requirements. Irrigators reviewed scenario IDP2.5.2.3 and expressed concerns about the impacts of droughts. They felt that occasional deficits over 100 mm could be tolerated but back-to-back deficits of this magnitude should be avoided. The irrigators recommended that a drought operation procedure be developed to address back-to-back deficits. It was felt that consumptive users could absorb the first year of a large deficit, but the impact of a second and third year deficit should be shared by instream habitat and consumptive users.

The objective of the drought procedures was to increase flow to Clear Lake and Twin Valley Reservoirs by amounts sufficient to eliminate successive 100 mm deficits. Increased diversions during increased runoff periods would build storage in Clear Lake and Twin Valley Reservoirs that could meet demands in low runoff periods. Of the additional scenario runs to account for droughts, IDP8CS1 was judged to be the best for meeting consumptive needs without impacting Base Case fish habitat.

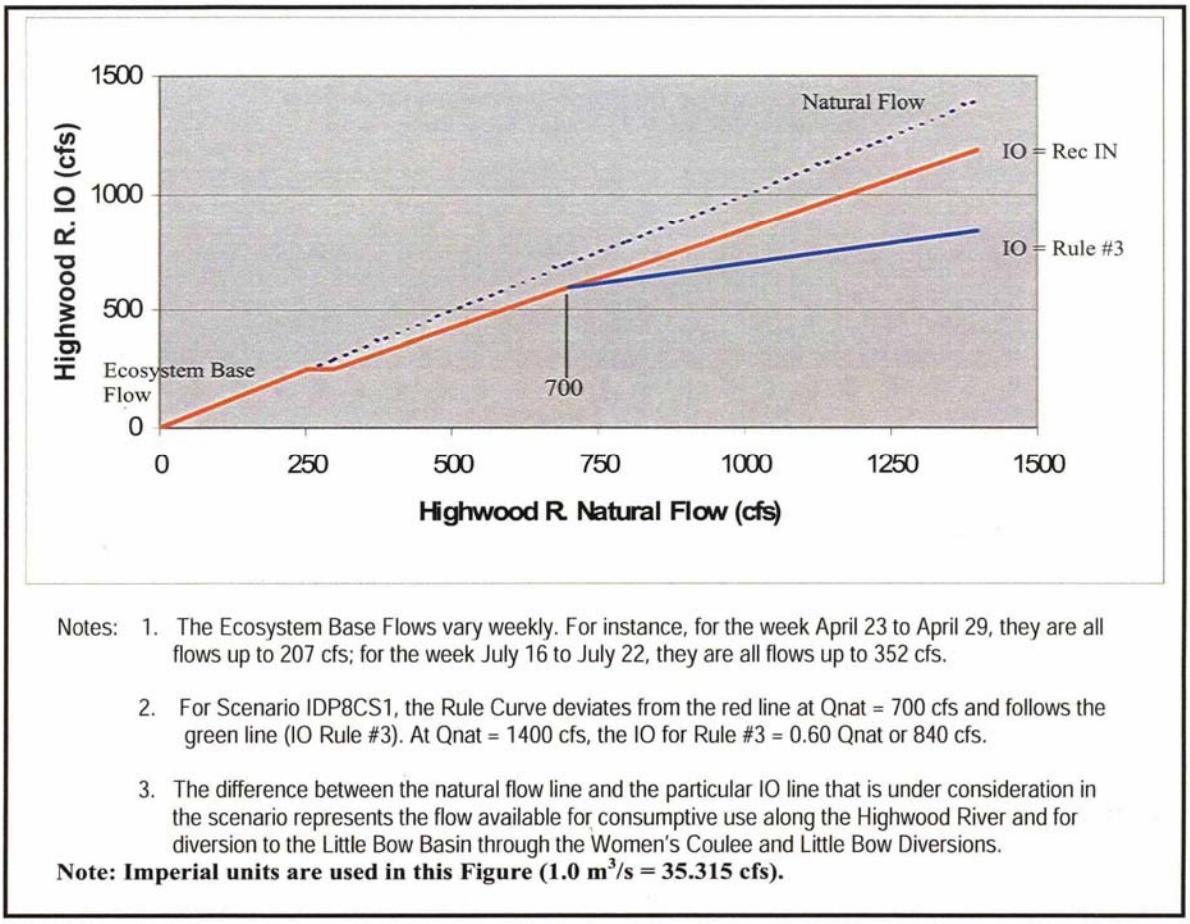

Figure 5: Highwood In stream Objective (IO) Rule #3[24]

[24] PAC Phase 1 Report, 2006, p. 36

The PAC judged scenario IDP8CS1 as the diversion plan that best meets the objectives of the Highwood/Little Bow project without negatively impacting pre-project water users, and without new storage while sustaining existing Highwood fishery habitat. The scenario uses a lower IFN value than that recommended by the Highwood Instream Flow Needs Working Group. The scenario falls short of the technical IFN primarily because of statutory commitments of pre-Little Bow Project licenses. The PAC indicates that while the Scenario IDPCS1 fails to meet the technical IFN, it is a substantial improvement in fish habitat over that of the Fish Rule Curve.

The PAC recognized the Working Group technical IFN in the evaluation of modeling scenarios. Considerable effort was made to minimize encroachment on the technical IFN while attempting to meet the other objectives of the project. However PAC determined that setting a Water Conservation Objective (WCO) based on the technical IFN would essentially shut down the basin for further water licensing in a community that is under increasing development pressure. The instream flow objective recommended by PAC and incorporated into the Highwood Diversion Plan – November 2006 does not meet the technical IFN but is an improvement over the original IFN derived using the Fish Rule Curve method.

The PAC and some fishery experts questioned the validity of the technical IFN assessment for the Highwood River because of the lack of supportive observed fish and related aquatic habitat data on the Highwood system. It is PACs view, that a WCO cannot be assigned to the Highwood River until the technical IFN has been validated or revised and a more comprehensive and integrated approach to establishing WCOs for the entire Highwood/Sheep/Little Bow system has been undertaken. PAC recommended that additional IFN investigations be given a high priority in Phase II of the Highwood Water Management Study.

The Board supports PAC's view that IFN work conducted to date needs to be validated and that this work be given a high priority in Phase II of the Highwood Water Management Study.

4.3: Highwood Diversion Plan – November 2006

The Government of Alberta (GOA) developed the 2006 plan to replace the 2004 Interim Highwood Diversion Plan and the Highwood Operations Guidelines. The updated plan is based on recommendations from PAC and is intended to meet the Water License requirements for the project.

According to the GOA, the objectives of the plan are to:

- Operate the Little Bow Project, including the Twin Valley Dam and Clear Lake Diversion as approved;
- Meet the existing licensed demands at least as frequently as they are met under Base Case conditions;
- Preserve the water quality in the upper Little Bow River and lower Mosquito Creek;
- Manage the impact of the new flow regime in the Upper Little Bow; and,
- Improve instream flow conditions for fish in the lower Highwood River.

General operating rules have been established that define the upper and lower limits of diversion for Woman's Coulee and Little Bow from the Highwood River and Clear Lake from Mosquito Creek. These diversions supply water to Women's Coulee Reservoir, Clear Lake and Twin Valley Reservoir.

The general rules for operation of the diversion facilities are outlined in Figure 6. These operational rules are for the normal operation plan and under the drought operation procedure as recommended by the PAC in the preferred IDP8CS1 scenario.

Diversion	Operation / Irrigation Season			Winter Season
	Apr 1 – Apr 30	May 1 – July 15	July 16 – Sept 30	Oct 1 – Mar 31
Women's Coulee Diversion, Canal & Mosquito Creek				
Maximum Diversion Rate[1]	1.70 m^3/s	1.70 m^3/s	1.70 m^3/s	0.283 m^3/s Note 2
Target Environmental Flow[3]	0.85 m^3/s	0.85 m^3/s	0.85 m^3/s	N/A[9]
Minimum Operation Flow[4]	0.283 m^3/s	0.283 m^3/s	0.283 m^3/s	N/A[9]
Clear Lake Diversion[6]				
Maximum Diversion Rate[5]	1.70 m^3/s	1.70 m^3/s	1.70 m^3/s	0.0 m^3/s
Little Bow Diversion, Canal and Upper Little Bow				
Maximum Diversion Rate[7]	8.5 m^3/s	8.5 m^3/s	8.5 m^3/s	0.566 m^3/s or 50% of natural flows in the Highwood River, whichever is less.
Minimum Diversion Rate	0.566 m^3/s or 50% of natural flows in the Highwood River, whichever is less.			
Target Environmental Flow	1.133 m^3/s	1.133 m^3/s	1.133 m^3/s	N/A[9]
Minimum Operation Flow[8]	0.566 m^3/s	0.850 m^3/s	0.850 m^3/s	0.566 m^3/s
Twin Valley Releases to Lower Little Bow				
Minimum Operation Flow[10]	0.566 m^3/s			

Notes:
[1] Subject to Highwood River Instream Objective rules described below. Flow is metered at the diversion near the Highwood River.
[2] Emergency winter supply (e.g. Village of Cayley)
[3] Measured at Mosquito Creek upstream of Clear Lake Diversion.
[4] Calculated upstream of Twin Valley Reservoir.
[5] Subject to the minimum operation flow being met for Mosquito Creek
[6] There are no target environmental or minimum operation flows for the Clear Lake Diversion or canal.
[7] Subject to Highwood River Instream Objective rules described below. Flow is metered at the Little Bow diversion near the Highwood River.
[8] Upstream of Twin Valley Reservoir.
[9] Not applicable because there will be no winter diversions except during emergencies.
[10] Measured upstream of Travers Reservoir

Figure 6: Operating periods, maximum, minimum diversion rates, target environmental flow and minimum operation flows[25]

[25] Government of Alberta Highwood Diversion Plan, 2006.

The Highwood Instream Flow Objectives used in the Diversion Plan vary according to the natural flow of the river which is consistent with the natural flow paradigm. Instream Flow Objectives are not equivalent to the technical IFN recommended by the Highwood River Instream Flow Needs Working Group, but according to the PAC represent a significant improvement over IFN recommendations derived from the Fish Rule Curve in the mid-nineties.

Three special operating requirements are established in the Diversion Plan where diversions will be managed to address Highwood River stress conditions, drought conditions and flood conditions. In addition, the GOA has indicated that diversions will be managed to improve the aquatic and riparian environment when conditions are suitable.

1. **Highwood Stress Conditions**

   The Highwood is considered to be under stress:

   a. when flow in the Highwood, downstream of the Little Bow Canal is less than 4.25 m^3/s (150 cfs). Only water that is absolutely necessary to meet domestic and licensed, municipal, industrial and irrigation uses should be diverted from the Highwood. The Board is in agreement that in low flow conditions, every attempt should be made to prevent the flow in the Highwood downstream of the Little Bow Canal Diversion from continuing to fall.

   b. if the water dissolved oxygen level is less than 5 mg/l or the water temperature exceeds 24°C in the Highwood downstream of High River (as measured at the Aldersyde water survey station). If either of these conditions are met:

      - diversions for irrigation during normal or drought conditions will be temporarily suspended;
      - the Little Bow Diversion from the Highwood will be limited to 0.566 m^3/s (20 cfs) or 50% of the natural flow when flow is less than 1.13 m^3/s (40 cfs); and
      - the Women's Coulee Diversion will be shut down.

2. **Drought Conditions**

   Diversions will be conducted according to general operating conditions in the 1st year of drought. In the 2nd and 3rd years of a drought, some diversion will be allowed for reservoir recharge. These diversions are subject to Highwood Stress conditions.

3. **Flood Conditions**

   During flooding events, diversions are managed appropriately to minimize downstream flooding and damage. A major consideration in deciding diversion flows during and after flooding events is the condition of downstream reservoirs and their operations.

The Diversion Plan indicates that prior to reaching Highwood River stress, drought or flood conditions, an 'Alert Condition' will be declared. An alert condition will be declared when the following stress conditions are approached in the Highwood:

a. Water temperature is between 22.5 °C and 24 °C;

b. Dissolved Oxygen is between 5 mg/L and 5.5 mg/L; or

c. Natural river flows are approaching 4.2 m^3/s (150 cfs).

Figure 7 summarizes the conditions under which the Highwood River would be considered to be under stress conditions and when it is approaching stress conditions (i.e., Alert Condition). Under an alert condition related to stress conditions in the Highwood River, appropriate action will be taken including notifying irrigators of the possibility of diversion cutbacks and conducting additional monitoring (e.g. dissolved oxygen, temperature).

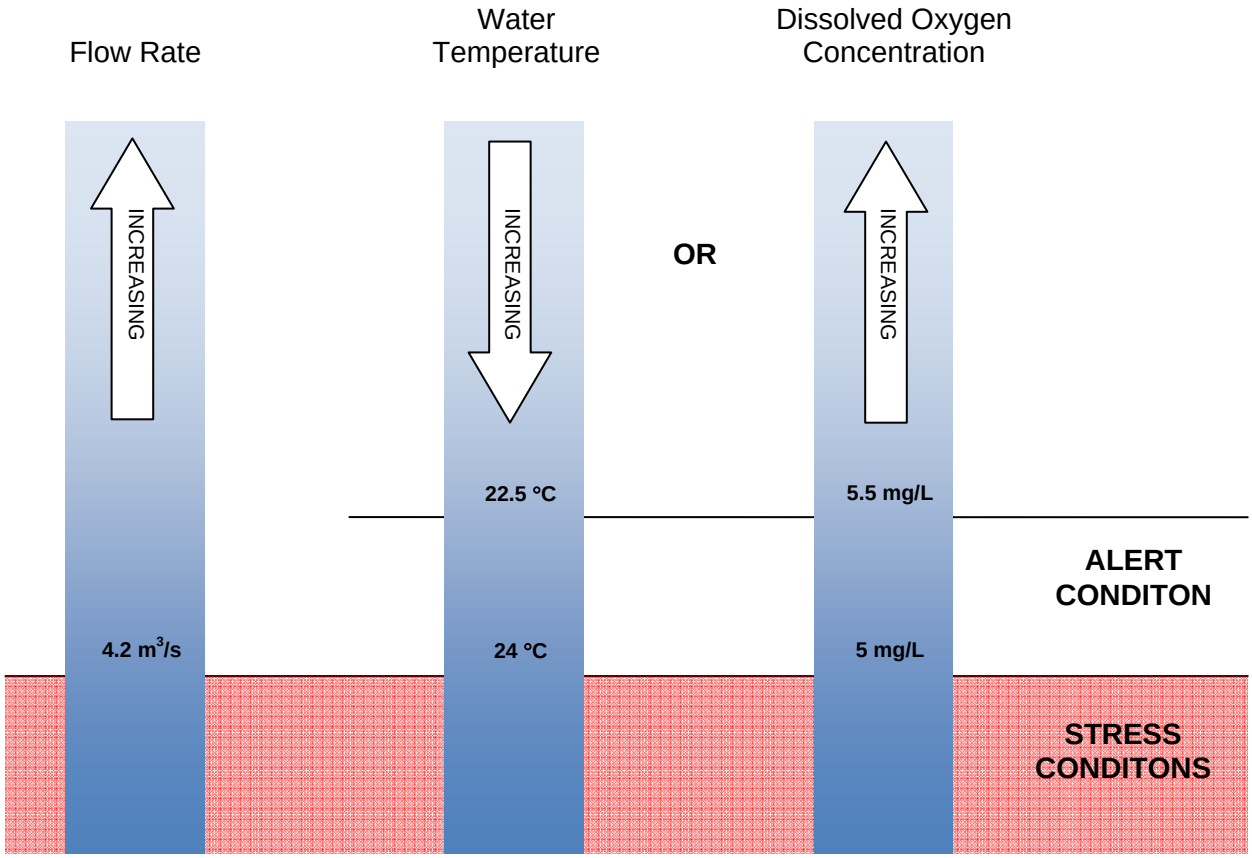

Figure 7: Stress and Alert Conditions in the Highwood River

The Board notes that the Diversion Plan does not provide details on the procedures and conditions for declaring an Alert Condition related to drought or flood conditions in the Highwood River. The Board recommends that these procedures and conditions be developed for the Highwood and detailed in the Diversion Plan.

The Board supports the adaptive management approach to performance management which has been incorporated in the GOA Highwood Diversion Plan - November 2006. Critical elements of performance management include the development and implementation of a

monitoring program and a performance assessment strategy to evaluate the effectiveness of the Highwood Diversion Plan in achieving the water management objectives and for making adjustments that may need to be made to meet the objectives of the project. There are numerous monitoring programs presently underway in the Highwood/Little Bow basin. Both AENV and the PAC agree that an inventory of the monitoring programs presently underway should be prepared, baseline conditions established for all monitored parameters and a detailed monitoring program prepared.

The Board notes that AENV has indicated their willingness to work in partnership with a Watershed Stewardship Group to conduct the monitoring inventory, establish baseline conditions for all monitored parameters and prepare a detailed monitoring program. While the Board supports the conversion of PAC to the recommended Highwood Watershed Stewardship Group, it does have concern for the time it may take to establish a Stewardship Group and the subsequent delay in the acquisition of monitoring data which is essential for monitoring the performance of the project. The Board recommends that AENV take responsibility and initiate the monitoring programs review as soon as possible. The establishment of the Watershed Stewardship Group can occur concurrently with AENV's review of monitoring programs.

It is the Board's understanding that AIT has recommended an aquatic monitoring program that includes monitoring fish populations in the Little Bow River. Since the Highwood River is a renowned sports fishery and recognized as an integral component to sustaining the Bow River as a world class fishery, the Board recommends that GOA develop a comprehensive fish population monitoring plan for the Highwood River. This information would form a crucial foundation for validating the revised IFN, assessing the success of the adaptive management approach and assist in monitoring the long-term viability of the Highwood fishery.

SECTION 5: THE NEED FOR STORAGE

Although it did not form part of the original application, the Joint Review Panel issuing Board Decision 9601-1 felt it was important to evaluate the potential for additional storage to help mitigate the tremendous consumptive demands for water in the Highwood-Little Bow Basins as well as maintenance of fish habitat in the Highwood. Clearly if additional storage was deemed to be a necessary component of water management in the basin a completely new and separate application may be required.

In addition, the Joint Review Panel also asked that the IFN analysis for the Highwood be re-visited and updated with the current science regarding requirements for fish habitat and river structure needs and without regard to meeting consumptive demands. These two pieces of work progressed independently until completion of the new IFN (Technical IFN Working Group completed their analysis in 2002). The new science based IFN was then used by the PAC in conjunction with storage scenario runs to determine the impact that storage would have on improving IFN in the Highwood. For a more detailed discussion of the IFN analysis refer to Section 4.1.

The Joint Review Panel also felt that there were fundamental principles that needed to be respected in the development of water management projects and diversion plans. These were outlined in the original joint report from NRCB/CEAA of May 1998, page 8, section 5:

> *"First, water management projects must respect existing riparian rights and water licenses, and should not result in the loss or injury to existing water rights.*
>
> *Second, water management projects must be able to meet basic environmental criteria to avoid significant adverse effects.*
>
> *Third, water management projects must be able to meet current and future needs for domestic, riparian, and municipal needs, and other consumptive uses.*
>
> *These environmental, social and economic considerations are basic to the determination of the public interest. A project must be able to meet these three criteria to be worthy of detailed consideration by the Panel with respect to project effects."*

As such there were several conditions related to storage placed on the Applicant in the Board Order 9601-1.

5.1: From the Board Order 9601-1

Condition 3 of 9601-1:

> *"The Operator shall complete its economic, social, and environmental assessment of the effects of the Super Expanded [Women's] Coulee project component within twelve months of the date of issuance of this Order."*

Condition 5 of 9601-1:

> *"The Operator shall update the comparative analysis of potential storage sites within the Highwood River Basin. The comparative analysis shall include among other sites, the Super Expanded [Women's] Coulee site, Stimson Creek Site 8 and the Tongue Creek Site 4, and shall include comparative data regarding environmental, social and economic effects for each site identified. The comparative analysis should form part of the completed assessment of the Super Expanded [Women's] Coulee Reservoir."*

Previous panels received various submissions from Alberta Transportation in 2001 and 2002 incorporating the analysis summarized above. Following are relevant excerpts from progress reports filed by previous Panels on the analyses undertaken by Alberta Transportation to determine which site provided the greatest promise for storage if it were indeed required. These excerpts show that previous Panels were satisfied that sufficient analysis was undertaken by Alberta Transportation to conclude that if storage were deemed appropriate the Women's Coulee site would be preferred.

From the *Review of Progress Toward Meeting Board Order 9601-1 (June 2001)*:

> *"The Panel believes that this comparative analysis does not require a detailed assessment of each site. In suggesting a "fatal flaw" analysis the Panel was seeking a summary evaluation that would quickly establish the relative merits of each possible site. The Panel was not asking Alberta Transportation to identify one single factor that might preclude development at any particular site, but rather to determine whether there might be a combination of factors that would establish the inferiority of superiority of that site relative to the Women's Coulee site."*

From the *Review of Progress Toward Meeting Board Order 9601-1 (February 2002)*:

> *"Alberta Transportation submitted that its September 2001 report fulfils the requirements of Condition 5 and further noted that its analysis provided the PAC and Alberta Environment with additional information to assess the role that storage could play in addressing water demands in the Highwood basin. Alberta Transportation also stated that, even if further comparative studies were undertaken, it believed that the relative ranking of the three sites would not change.*
>
> *Although most parties agreed that Alberta Transportation's comparative assessment was not entirely complete, the majority also agreed that additional studies would not have resulted in a different relative ranking of the three sites. A number of parties also stated that they believed that the Comparative Site Assessment fulfilled Condition 5 of the Board Order. However, some parties argued that the assessment remained incomplete, mainly because of the limited time that Alberta Transportation had been given to complete the analysis. These parties suggested that additional assessment of potential impacts on water quality, groundwater, soil salinity and visual resources was required. Some also suggested that inconsistent criteria were used to assess project costs and they submitted that a more complete assessment of these costs was required before the PAC could effectively compare the cost-effectiveness of storage and non-storage options.*
>
> *Having reviewed the Comparative Site Assessment and the evidence provided by all the parties, the Panel has determined that the report does meet Condition 5 of the Board Order. The report clearly provides "comparative data regarding the environmental, social and economic effects" for each of the three sites. Furthermore, the analysis is sufficiently detailed to allow Alberta Transportation to confirm that Women's Coulee is in all likelihood the best of the three potential storage sites. While more studies could have provided additional information, the Panel believes that the overall content of the report is sufficient to fulfill its intended purpose.*
>
> *According to Alberta Transportation, the results of its Comparative Site Assessment indicated "the Women's Coulee site provides the best opportunity for the development of storage within the Highwood River basin having regard for cost and social and environmental impacts." In reaching this conclusion,*

Alberta Transportation employed the evaluation criteria set out in the Joint Review Panel's 1998 Decision Report as summarized on page 6 of this report. According to Alberta Transportation's assessment, both the Tongue Creek and Stimson Creek sites were smaller in size, would be more expensive to build, and would have greater adverse environmental and/or social impacts.

The Panel recognizes the difficulty facing Alberta Transportation and Alberta Environment in selecting a preferred site before the need for storage has been conclusively proven. At the same time, the Panel believes that it would be in the public interest to provide some direction to both government and the public with

regard to its views on the most likely scenario. Therefore, based on the information before it, the Panel accepts that the Women's Coulee site represents the most appropriate site for foreseeable storage within the Highwood basin. It has received no information showing that there is a better site elsewhere in the basin. This should not be construed to mean that the Panel has concluded that storage is necessary. The Panel will wait for the results of the HMP before reaching any conclusions on this issue.

Based on the results of the comparative analysis, the Panel does believe that, for the foreseeable future, it is highly unlikely that the Alberta Government would propose to develop water storage at either the Tongue Creek or Stimson Creek sites. While the Panel cannot state with absolute certainty that water development could never be required at another site in addition to the Women's Coulee site, both the Tongue Creek and Stimson Creek sites clearly appear to be significantly less suitable for providing water storage."

5.2: Comparative Storage Site Assessment

The comparative site assessment undertaken by Alberta Transportation showed that the Super Expanded Women's Coulee was the preferred site based on an analysis of social, economic and environmental impacts. Since no application for expanded storage was made to the NRCB there was no requirement for a comprehensive Environmental Impact Assessment (EIA). A 'fatal flaw' analysis was requested and undertaken using criteria set out from the original Board Decision document on page 15 of section 8:

- Highwood River on-stream storage is not acceptable due to conflicts with fisheries requirements;
- Total reservoir capacity must be equivalent or larger than the Super Expanded Women's Coulee site;
- Cost of developing storage should be equivalent to or less than Super Expanded Women's Coulee site expressed on a cost/acre foot basis;
- Predicted water quality effects on the Highwood River must not be significant adverse effects;
- The outlet to Highwood River from the storage site is above the Little Bow diversion at the town of High River;

- The adverse social and environmental impacts should be less than or equal to those associated with the Super Expanded Women's Coulee Reservoir.

Three potential sites were assessed; the Super Expanded Women's Coulee, Tongue Creek (Northwest of High River) and, Stimson Creek (North of the Chain Lakes Reservoir). In order to assess each of the three potential sites under the criteria set out by the Panel (above) the following technical work was undertaken on each site:

- Feasibility level engineering;
- Road network studies;
- Market value of required land for reservoirs;
- Cost assessments;
- Impacts on groundwater, soils/terrain, vegetation, wildlife and historical resources;
- Fisheries and water quality impacts;
- Visual impact assessments.

Based on these assessments it was determined that the Super Expanded Women's Coulee was the preferred site. Environmental impacts, storage capacity and cost per unit of water stored were the three key drivers that led to the selection of Women's Coulee. In 2001 dollars the estimated cost per supplied dam^3 of water for the three sites were:

Super Expanded Women's Coulee	\$2,577 / dam^3
Tongue Creek	\$4,132 / dam^3
Stimson Creek	\$5,255 / dam^3

Also noted by the Applicant was a comparison to the typical cost of supplying water for irrigation projects being in the range of \$1,000 - \$2,000 / dam^3. Given the results of the fatal flaw analysis the Board concurs with the assessment made by the previous Joint Review Panel that the Super Expanded Women's Coulee is the preferred site for water storage, if appropriate future need is identified.

5.3: Analysis of Storage Incorporating the New IFN (Super Expanded Women's Coulee)

From the earlier analysis completed by Alberta Transportation and summarized above it was clear that the Super Expanded Women's Coulee was the preferred storage site. However, the analysis thus far was undertaken on a comparative basis between three potential sites based on total storage capacity and regard to impact on social, economic and environmental concerns.

Further analysis was completed once the Women's Coulee was selected as the preferred site. This analysis incorporated the new work on IFN completed by the Technical Working Group. Under the stewardship of the Public Advisory Committee numerous scenarios were run using Alberta Environment's water supply/demand models for river basins. A total of 60 scenarios were run to evaluate the impact of various diversion plans and their impact on instream

objectives for the Highwood. Several of these scenarios were based on a 'with or without' analysis using the Super Expanded Women's Coulee storage option.

In the scenario modeling done by PAC for additional storage, operation of the reservoir was dedicated to improving instream flow conditions on the Highwood. Women's Coulee would not be used to reduce deficits to consumptive users experienced with the best scenario without storage (IDP8CS1). Modeling showed that increasing the size of the Super Expanded Women's Coulee inlet canal and providing return flow to the Highwood would not significantly improve instream flow conditions along the Highwood. This is largely due to the new IFN analysis which incorporates the 'natural flow paradigm'. In earlier studies much more water was diverted to the Super Expanded Women's Coulee during the spring freshet, however, following the new IFN and natural flow paradigm resulted in much less water being diverted.

Previous studies following the Fish Rule Curve approach presented in the original application documents would allow diversion at full capacity any time the Highwood flows were above 24.4 m^3/sec (860cfs). The new recommendation of the Technical Working Group would not allow full diversion to occur until flows in the Highwood reached 68.0 m^3/sec (2400cfs). Instream Objective (IO) Rule 3 which is incorporated into the PAC preferred scenario (IDP8CS1), encroaches on the Technical Working Group recommendation and would allow somewhat higher diversions (31.1 m^3/sec, 1100cfs) when impact on fish habitat is somewhat lesser. Using IO Rule 3 in the scenario runs with storage resulted in somewhat better results for the Highwood; however, improvements were still seen as not significant.

Impacts on habitat for adult Mountain Whitefish were used extensively in PAC's analysis. Adult Mountain Whitefish are among the most sensitive to habitat losses. All other species and life stages would be impacted to a lesser extent. Figure 8 shows the impacts of various scenarios on adult Mountain Whitefish habitat.

In Figure 8 it is important to note the relative indifference on habitat impacts when comparing pre and post project results with storage and without additional storage. The pre-project base case is shown with scenario BC2.2; adding storage is shown with scenario IDP.EWC.4.1 and the best case scenario (chosen by PAC) without storage is IDP8CS1. The results showing relative indifference between options with and without storage are consistent across all measures (overall habitat, the July-August low flow period, and both yearly/weekly maximum reductions). The only significant improvement to habitat occurs when Technical IFN is used as the only criteria; however, under this scenario licensed consumptive water demands are no longer met.

The impact on annual habitat was charted for the above scenarios across the years 1928 through 1995. Charting indicated there was very little difference to the impact on habitat between these scenarios in nearly every year. This was due to the fact that under Instream Objective Rule 3, maximum allowable diversions did not provide sufficient storage, and return flows to the Highwood did not significantly impact habitat. Therefore, improvements to Highwood instream flows and fish habitat for scenarios with and without storage showed very little difference. An additional limiting factor was the restriction on the Women's Coulee reservoir size. The size of the reservoir was restricted to prevent damage to the Women's Buffalo Jump, an archeologically significant site.

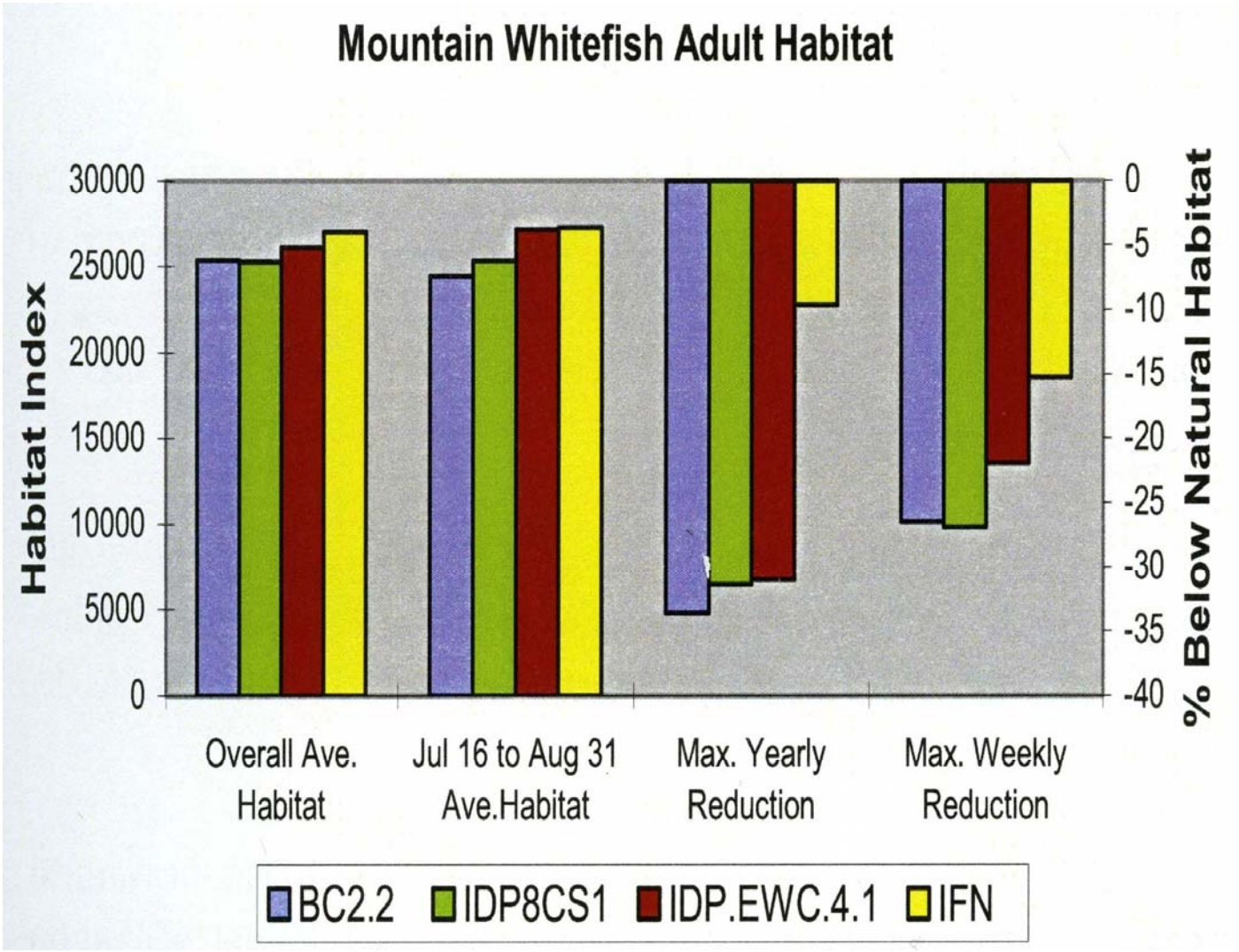

Figure 8: Comparative fish habitat performance for Scenario IDPEWC4.1[26]

Scenarios run by Government technical committee members and vetted through the PAC show the substantial difference between previous assessments made using the Fish Rule Curve (FRC) versus the Instream Objective Rule 3 (IO Rule 3, a compromise to the technical IFN). Earlier estimates of IFN using the FRC would have allowed substantially greater diversions, especially during the high flow weeks between week 17 and week 30. Using IO Rule 3 there would be significant reductions in allowable diversions in order to maintain natural inter-annual and intra-annual flow variations (respecting the natural flow paradigm). The difference between earlier analyses using the FRC versus the PAC adopted IO Rule 3 over time is shown in Figure 9.

[26] PAC Phase 1, 2006, pg. 38.

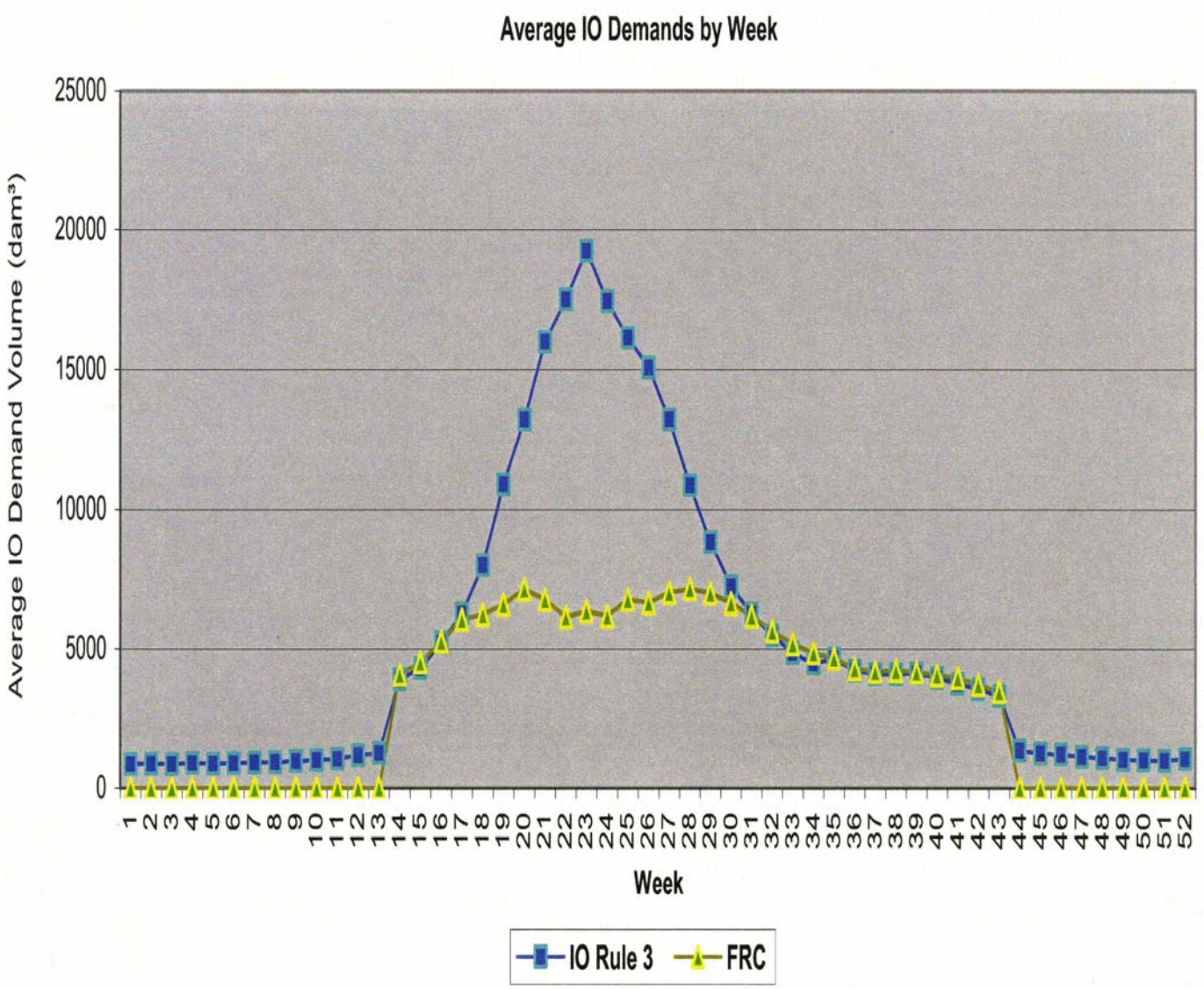

Figure 9: Average weekly instream requirements – Rule 3 versus Fish Rule Curve[27]

As seen in Figure 10 under IO Rule 3, significantly less water is available for diversion to storage as compared to the original analysis using the FRC. Given the instream needs characterized by technical IFN the annual volume of water available for diversion was calculated and graphed in Figure 8. This illustrates the amount of water that could be diverted while respecting the Technical IFN. Relatively small amounts of water under this scenario could be diverted to storage with the exception of several extreme high flow years. There are also many years when little or no water could be diverted and frequently these occurred in successive years.

[27] PAC V. 2, p. 67.

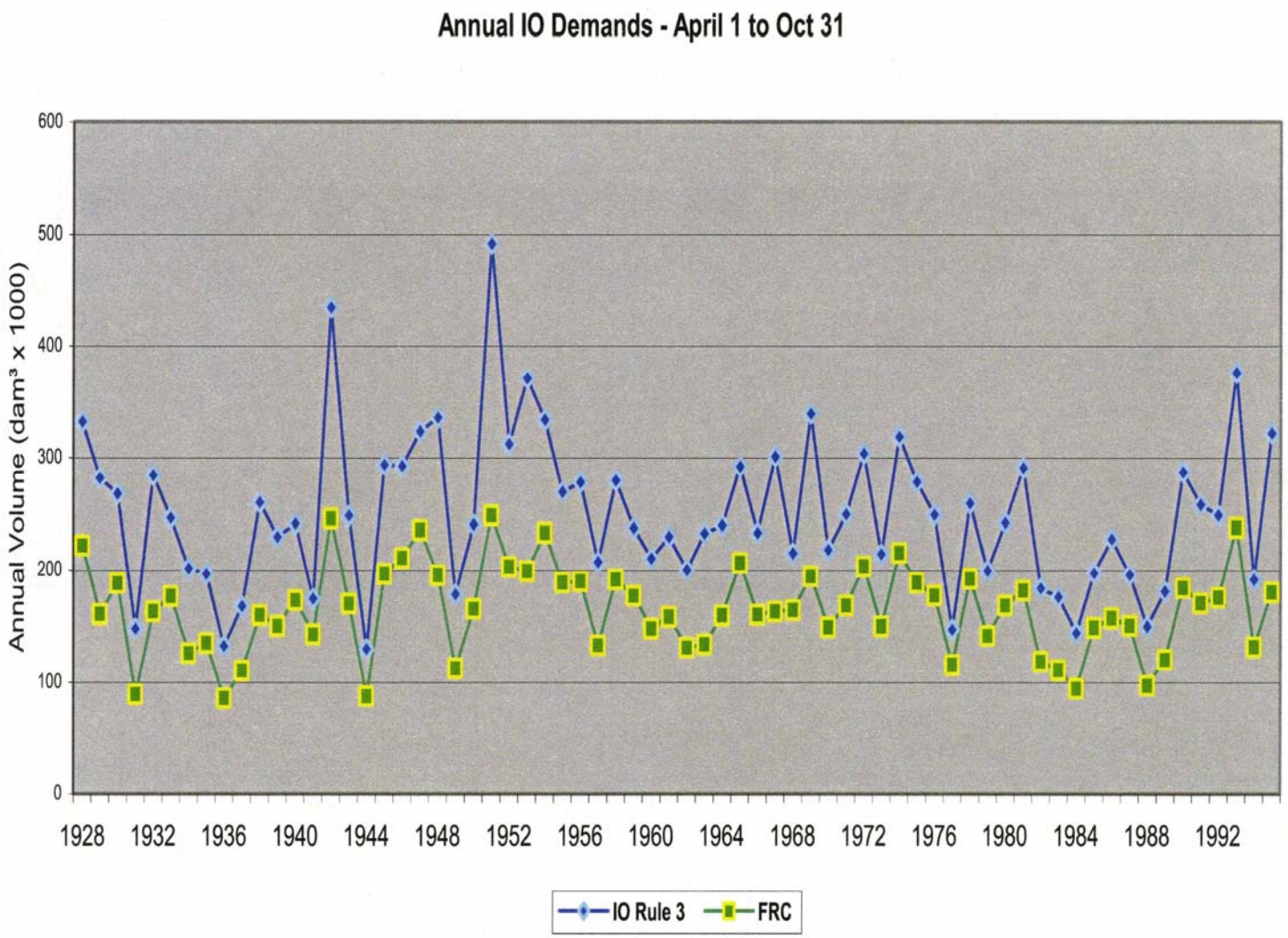

Figure 10: Annual instream requirements – Rule 3 versus Fish Rule Curve[28]

Figure 11 illustrates water available for diversion under the PAC recommended IO Rule 3. Here it can be seen that substantially more water could be diverted from the Highwood for storage as compared to the scenario that respects the Technical IFN. However, there are still many years in which there is no available water for storage and in several years, these shortfalls occur in back to back years. It should be recognized that importance needs to be given to both the frequency of individual years and occurrence of back to back years where water is unavailable for storage. Both instream river needs and consumptive demands are greatest during these events. The primary purpose of storage is to supply water in times of significant low flow periods. It has been shown that water diversions for storage is often not available during these low flow periods.

[28] PAC, V.2, p. 67.

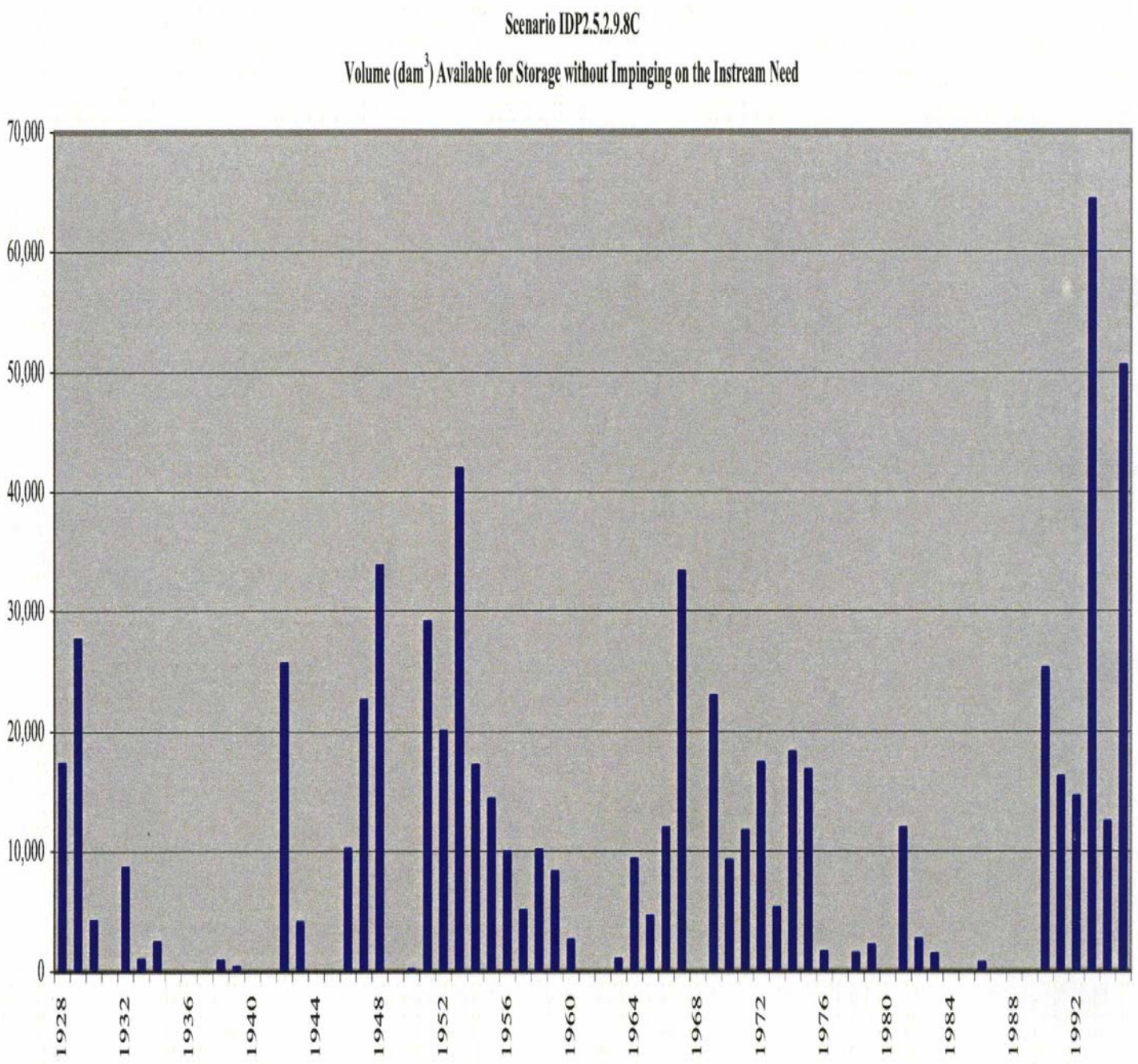

Figure 11: Volume of water available for storage (dam^3) without impinging on the recommended technical IFN[29]

[29] PAC V.2, p. 68.

Limitations on water diversions for storage are further illustrated in Figure 12. Minimum and maximum reservoir elevations are shown on an annual basis. In many years, the reservoir is not filled and minimum elevations are impinged upon. This represents a fundamental discrepancy between the reservoir size, diversion amounts and water demands for return flows to the Highwood River.

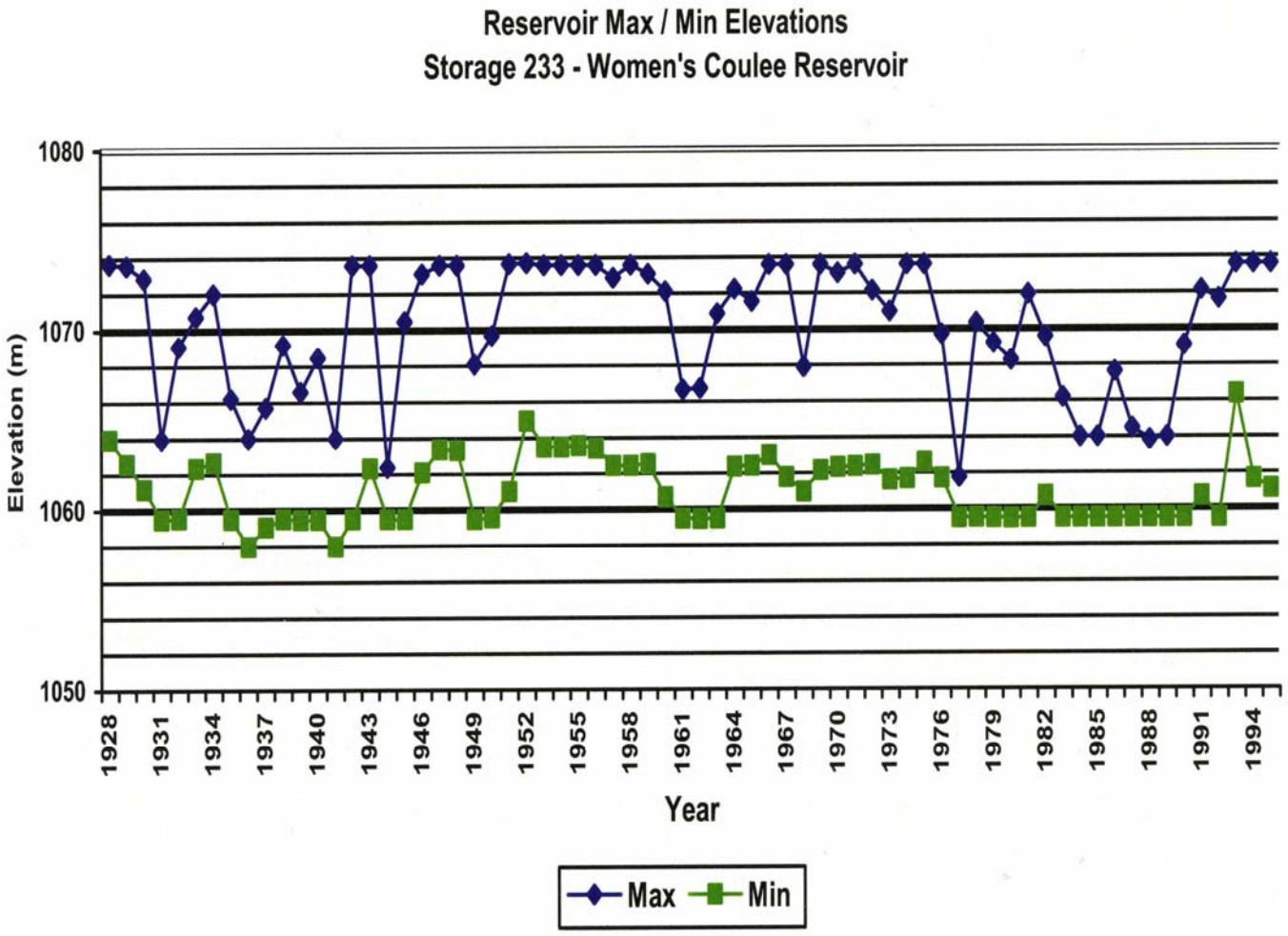

Figure 12: Maximum and minimum water levels for Super Expanded Women's Coulee Reservoir[30]

The primary objective of additional storage was to return flow to the Highwood in order to improve instream flows. Figure 13 shows the modeled return flows to the Highwood. In most years there remained deficits to the instream flow objective even after return flows from the reservoir. In some years there was no water available from storage to return to the Highwood.

[30] PAC V.2, p. 69.

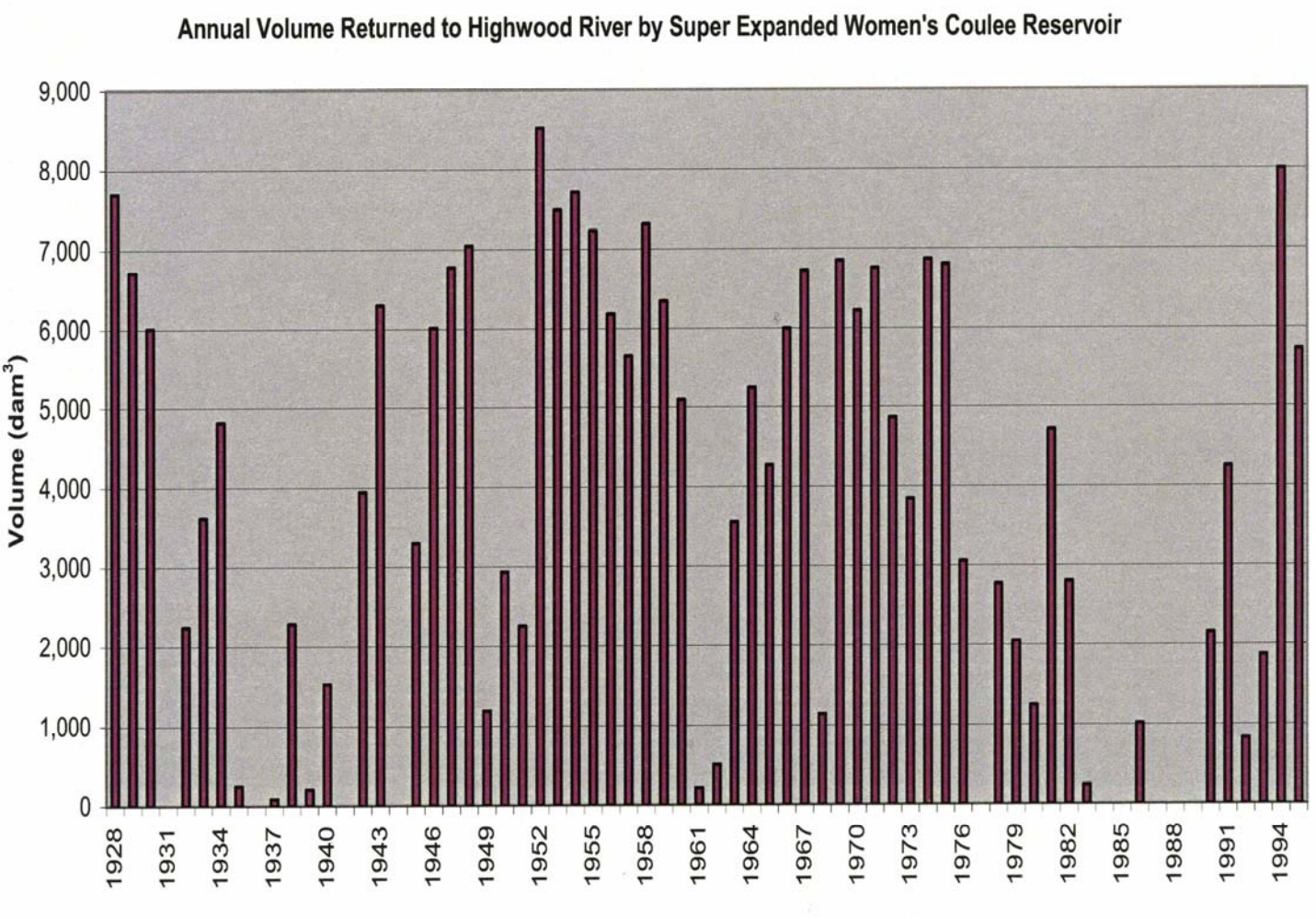

Figure 13: Annual volume of water returned to the Highwood River from Super Expanded Women's Coulee Reservoir[31]

5.4: Board Views and Conclusions on the Need for Storage

Comparative analysis based on costs, social implications and the environment showed that the Super Expanded Women's Coulee is the preferred site for storage as compared to Tongue Creek and Stimson Creek. If it were determined that storage improved instream flow needs on the Highwood, the Super Expanded Women's Coulee would be the preferred site. The Board also recognizes that requirements for information on additional storage were requested only to assist the Board in assessing whether or not the Applicant fully addressed all options for maintaining and/or improving Highwood IFN within the diversion plan.

[31] PAC V.2, p. 69.

Extensive analyses were carried out by the PAC evaluating numerous scenarios with and without expanded storage. These analyses focused on evaluating the impacts that increased storage would have on instream flows in the Highwood. In order to carry out the analysis, PAC used historical flow data from the Highwood River. Data used was from 1928 through 1995. For all scenario runs, historical data was run in sequence, that being from 1928 through 1995. The Board supports this modeling approach. Under study were the impacts on fish habitat, ability to fill the reservoir over time, and the potential for reducing negative impacts during drought years. The Board also supports the criteria used by PAC in evaluating the merits of scenarios which included both storage and non-storage options. While this analysis is by no means 100% conclusive it represents advanced thinking and current science in determining probable outcomes with respect to instream river needs and modeling using historical water data.

There has been a substantial change in thinking and scientific evidence with respect to determining IFN. This has also led to a substantial change in the results and conclusions related to the benefits that storage can offer in improving instream flows for the Highwood River. The Board is in agreement with the approach taken by the Applicant with respect to modeling and determination of the revised Technical IFN.

Scenarios that to the extent possible respect the requirements of the Technical IFN show that, additional storage would not significantly improve instream conditions along the Highwood River. Furthermore, attempts to meet Technical IFN would not allow the government to fulfill its legal obligations to licensed water users in the basin.

The IO Rule 3 was adopted by the PAC in order to maximize instream conditions along the Highwood River while meeting licensed water demands in the basin. These analyses consistently show that diversion limitations that respect to some degree the new thinking around ‘natural flow paradigm’ (reflected in IO Rule 3) will not allow for sufficient storage to significantly improve instream objectives on the Highwood. Factors that contribute to the inability of storage to significantly improve Highwood River IFN are:

- Scenario runs showed that there were many years in which no water was available for storage;
- Scenario runs also showed that there were frequent occurrences of back-to-back years in which no water could be diverted for storage. The highest need for stored water to return to the Highwood to improve instream flows and habitat occur in drought years, the very time in which no water is available even with storage; and
- Capacity of the Super Expanded Women’s Coulee was limited. This limitation was imposed in order to protect the important archeological site of Women’s Buffalo Jump.

Given the costs and social/environmental impacts of constructing a reservoir at Women’s Coulee, the Board concurs with the most recent conclusions from PAC with respect to storage. Additional storage would not provide clear benefits over associated costs with respect to improving IFN along the Highwood.

SECTION 6: BOARD DECISION

The Board has carefully considered all information submitted by the applicant filed in response to conditions set out in Board Decision 9601. The scope of this review is limited to the Highwood Diversion in the low flow summer season and the construction and operation of the expansion of the Women's Coulee Reservoir. The updated IFN and the Highwood Management Plan, were never intended to be set before the NRCB for approval as they are beyond the Board's jurisdiction. This information and data provided pursuant to the Board Order was, however, used to inform and support the current decision-making process.
The original instream flow needs (IFN) work on the Highwood River that started in the mid-1980's was done from a relatively narrow perspective of identifying flows for selected sport fish. Substantial work has been done since by the Highwood River IFN Technical Working Group and by the PAC to upgrade the Highwood IFN using updated information and current science. The Board concurs that there is no single method, or universally accepted way to determine IFN and acknowledges that significant progress has been made in updating IFN requirements for the Highwood River since original instream flow work was conducted. A substantial improvement was the consideration of the natural flow paradigm in the IFN determination which stresses the importance of maintaining inter-annual and intra-annual flow variation to promote biodiversity. The Board understands that IFN determination is an evolving science and that the quality of IFN determinations will progress with increasing data and evolving science. As such, the Board supports PAC's view that IFN work conducted to date needs to be validated as more information about the Highwood River is collected.

The Board supports the adaptive management approach to performance management which is being used in the GOA Highwood Diversion Plan - November 2006. Critical elements of performance management include the development and implementation of a monitoring program and a performance assessment strategy to evaluate the effectiveness of the Highwood Diversion Plan in achieving the water management objectives and for making adjustments that may need to be made to meet the objectives of the project. There are numerous monitoring programs presently underway in the Highwood/Little Bow basin. Both AENV and the PAC agree that an inventory of the monitoring programs presently underway should be prepared, baseline conditions established for all monitored parameters and a detailed monitoring program prepared. It is the Board's understanding that AIT has recommended an aquatic monitoring program that includes monitoring fish populations in the Little Bow River. Since the Highwood River is a renowned sports fishery and recognized as an integral component to sustaining the Bow River as a world class fishery, the Board recommends that the GOA develop a comprehensive fish population monitoring plan for the Highwood River as well. This information will form a crucial foundation for validating the revised IFN, assessing the success of the adaptive management approach and assist in monitoring the long-term viability of the Highwood fishery.

While the Board supports the conversion of PAC to the recommended Highwood Watershed Stewardship Group, it does have concern for the time it may take to establish the Group and the subsequent delay in the acquisition of monitoring data which is essential for monitoring the performance of the project. As a result, the Board recommends that AENV take responsibility and begin the monitoring programs review as soon as possible. The establishment of the Watershed Stewardship Group can occur concurrently with AENV's review of monitoring programs.

The PAC worked with AENV and AIT to conduct computer simulation modeling to test numerous scenarios for the operating plan. The testing considered the objectives established by the Joint Review Panel, the technical Highwood River IFN recommended by the Instream Flow Needs Technical Working Group and the findings of AIT with regard to new storage requirements in the Highwood River Basin. The Board supports the scenario analysis used by the PAC and the criteria used by PAC in evaluating the merits of scenarios which included both storage and non-storage options. Given the costs and social/environmental impacts of constructing a reservoir at Women's Coulee, the Board concurs with the most recent conclusions from the PAC with respect to the need for storage. Additional storage in the Highwood Basin would not provide clear benefits over associated costs with respect to improving IFN along the Highwood.

The November 2006 Highwood Diversion Plan contains general operating rules that define the upper and lower limits of diversion for Woman's Coulee and Little Bow from the Highwood River and Clear Lake from Mosquito Creek. Three special operating requirements are also contained in the Diversion Plan to manage diversions to address Highwood River stress, drought and flood conditions. Stress conditions are defined by water temperature and dissolved oxygen levels. Stress conditions can also occur when the flow in Highwood downstream of the Little Bow Canal Diversion is less than 4.25 m3/s (150 cfs). The Board is in agreement that under these low flow conditions, every attempt should be made to prevent the flow in the Highwood downstream of the Little Bow Canal Diversion from continuing to fall. Only water that is absolutely necessary to meet domestic and licensed, municipal, industrial and irrigation uses should be diverted from the Highwood. The Board notes that the Diversion Plan contains an Alert Condition response to stress conditions in the Highwood River and recommends that a similar Alert Condition response also be developed and included in the Diversion Plan for drought and flood conditions in the Highwood.

The commitment of the diverse group of individuals who came together to form the PAC, with Alberta Environment's assistance, is acknowledged. The PAC process involved more than 100 meetings, many studies and considered numerous reports and statements in their deliberations. PAC is commended for their inclusivity, for the thorough nature in which issues were addressed and for making recommendations on how to effectively use water resources in the Highwood/Little Bow basins given competing demands. The high quality of the PACs work was acknowledged by AENV, who accepted virtually all of the PAC recommendations. In addition the GOA used the findings of the PAC process to develop the November 2006 Highwood Diversion Plan.

Following much examination and deliberation, the Board has concluded that the outstanding conditions of Board Decision 9601-1 have been addressed and that the 2006 Highwood Diversion Plan is in the public interest. While the Board finds that the Highwood Diversion Plan is in the public interest, it recognizes that GOA faces considerable challenges in addressing current and future consumptive and environmental needs for the Highwood River.

DATED at CALGARY, ALBERTA, this 7th day of April, 2008.

Original signed by:

Vern Hartwell, Chair	Dr. Gordon Atkins
Jim Turner	Donna Tingley

APPENDIX A:

THE PROVINCE OF ALBERTA

NATURAL RESOURCES CONSERVATION BOARD ACT
NATURAL RESOURCES CONSERVATION BOARD

IN THE MATTER of a revised Highwood Diversion Plan (the Project) for the Highwood River diversion to the Little Bow Canal in the Town of High River proposed by Alberta Environment and Alberta Infrastructure and Transportation

APPROVAL NO. NR–2008-1

WHEREAS Alberta Environment and Alberta Infrastructure and Transportation submitted an application for approval to the NRCB for a revised Highwood Diversion Plan (the Project) for the Highwood River diversion to the Little Bow Canal in the Town of High River as a reviewable project pursuant to NRCB Board Order No. 9601-1 issued in May 1998; and

WHEREAS the Natural Resources Conservation Board is prepared to grant approval to the application by Alberta Environment and Alberta Infrastructure and Transportation, subject to the conditions herein contained, and the Lieutenant Governor in Council has given authorization, hereto attached.

THEREFORE, the Natural Resources Conservation Board hereby orders as follows:

1. The project of Alberta Environment and Alberta Infrastructure and Transportation, being a proposal for a revised Highwood Diversion Plan (the Project) for the Highwood River diversion to the Little Bow Canal in the Town of High River, as described in Application No. 0603, filed December 12, 2006 and all supplemental material supporting the Application filed with the Natural Resources Conservation Board, is approved, subject to the undertakings and commitments in the application.

Made at the City of Calgary, in the Province of Alberta, this _____ day of _____, 2008.

NATURAL RESOURCES CONSERVATION BOARD

Vern Hartwell - Chair **Dr. Gordon Atkins - Member**

Jim Turner - Member **Donna Tingley - Member**

APPENDIX B:

Alberta

2938 – 11 Street NE
Calgary, AB T2E 7L7

Telephone (403) 297-6462
Fax: (403) 297-6069
Web www.gov.ab.ca

December 12, 2006

Ms. Susan Schlemko, Manager – Board Review
Natural Resources Conservation Board
4th Floor Sterling Place
9940 – 106 Street
Edmonton, Alberta T5K 2N2

Re: Board Order No. 9601-1

Dear Ms. Schlemko:

We are pleased to submit herewith the Revised Diversion Plan (Date: November 2006) for the Highwood River. We believe this is the final submission required by Board Order No. 9601-1.

Our submission also includes:

1. The two-volume Report and Recommendations for Highwood Diversion Plan submitted by the Highwood River Public Advisory Committee.
2. Response (Date: 04 December 2006) of Alberta Environment to the Public Advisory Committee's recommendations.

Twelve sets of the submission are being provided, along with a CD containing electronic copies. Please advise if additional sets are required.

The Revised Diversion Plan is congruent with the recommendations of the Public Advisory Committee, which represents a strong consensus in the Highwood River community for the balance between water diversion for the Little Bow project and protection of aquatic ecosystems.

The Public Advisory Committee studied over 60 scenarios using computer simulation over a period of four years to find an acceptable balance between water quality and habitat for fish in the lower Highwood River, protection of the aquatic environment of the Little Bow River and Mosquito Creek, and irrigation performance. Identifying an acceptable balance between water quality for fish and irrigation performance required extensive fine tuning and there is little flexibility in the system for other alternatives.

The diversion plan is based on computer simulation, therefore the system will be monitored for performance in real-time operations, and may require additional fine tuning as results come in.

The recommended Diversion Plan has the following key benefits and characteristics:

- River flows for fish in the lower Highwood River are improved over pre-Little Bow project conditions.
- Minimum flows have been established to protect the aquatic environment of Mosquito Creek and the Little Bow River. The new flow regime increases the opportunities to develop improved riparian habitat along the upper Little Bow River.
- The water supply for existing water users downstream of Twin Valley Dam is secured and water is available for 20,000 acres of irrigation expansion from Clear Lake and Twin Valley Reservoir, and along the Little Bow River between Twin Valley Dam and Travers Reservoir.
- Compared to pre-Little Bow project conditions, model results for the revised Diversion Plan indicate improved irrigation performance for licences diverting from the Little Bow River upstream of Twin Valley Reservoir and Mosquito Creek. These licences are both those with and without an end of July cutoff. In view of the improved performance, holders of the latter licences may want to consider applying for an amendment to their licences to have the cutoff removed.

The revised Diversion Plan does not incorporate an expanded Women's Coulee Reservoir. The Public Advisory Committee reviewed the assessment of the costs and impacts of this expansion along with evaluation of other potential water storage sites. The Public Advisory Committee generated scenarios with the additional water storage in place and evaluated the results. In the end the Public Advisory Committee concluded that the benefits of the additional storage did not outweigh the economic and environmental costs. We concur with that conclusion.

We await the final decision of the Natural Resources Conservation Board on the Highwood Diversion Plan. We trust you will let us know if any additional information is required to assist the Board in making its decision and will advise us on the steps required to bring this process to a conclusion.

Yours truly,

Jay Litke
Director
Southern Region
Alberta Environment

Denis Magowan
Director
Water Management
Operations
Alberta Environment

Ron Middleton
Director
Environmental Management
Services
Alberta Infrastructure and
Transportation

cc. S. Pickering

APPENDIX C:

Canadian Environmental Assessment Agency
President
160 Elgin St., 22nd floor
Ottawa ON K1A 0H3

Agence canadienne d'évaluation environnementale
Président
160, rue Elgin, 22e étage
Ottawa ON K1A 0H3

MAI MAY 17 2007

Mr. Vern Hartwell
Chair
Alberta Natural Resources Conservation Board
4th Floor Sterling Place
9940 -106 Street
Edmonton AB T5K 2N2

Dear Mr. Hartwell:

I am writing regarding the revised diversion plan for the Highwood River Diversion Project, submitted on December 14, 2006 by the proponent, Alberta Environment and Alberta Infrastructure and Transportation.

As you are aware, the five original components of the project were considered by a previous joint Canada-Natural Resources Conservation Board (NRCB) review panel which issued its final report in May 1998. In its final report, the previous joint review panel (JRP) recommended the approval of three project components: the Little Bow River dam and reservoir near Champion; the enlargement of the Highwood River water diversion structure and canal at High River; and the Clear Lake water diversion structure and canal near Stavely. At the same time, the previous JRP deferred coming to conclusions regarding the two remaining components. Instead, it requested that the proponent undertake further studies and resubmit a revised proposal for those components. The two remaining components included an expanded water storage reservoir at Women's (Squaw) Coulee and the Highwood River Diversion Plan for low flow season.

A second joint Canada-NRCB review panel was established in March 2000 to consider further submissions by the proponent. Between 2000 and 2002, the JRP held four public meetings to review the proponent's progress. However, the JRP has not convened since 2002, while the proponent has continued work to complete its revised diversion plan. I understand that the members of the JRP are no longer available.

The proponent has now completed its revised Highwood River Diversion Plan for low flow season and has concluded that the benefits of additional storage would not be sufficient to offset the economic and environmental costs. Accordingly, the revised diversion plan does not incorporate additional water storage and the proponent is no longer seeking to expand the Women's (Squaw) Coulee reservoir. In addition, no federal authority has any power to exercise or duty or function to perform regarding the revised diversion plan for low flow season as currently proposed.

.../2

In light of this, no federal environmental assessment (EA) is required under the *Canadian Environmental Assessment Act* (the Act) and no formal termination of the federal EA pursuant to s.27 of the Act or further federal action is required in respect of the remaining components of the project as currently proposed. I have concluded, based on this information, that there would be no benefit in reopening the joint Canada-Alberta agreement of March 2000 and reappointing a JRP.

If you would like to discuss this matter further, or require clarification, please contact Bruce Young, Director, Panel Management at the Canadian Environmental Assessment Agency by telephone at (613) 957-0791 or by email at bruce.young@ceaa-acee.gc.ca.

Yours sincerely,

Jean-Claude Bouchard

c.c.: Larry Murray, Deputy Minister, Fisheries and Oceans Canada
Louis Ranger, Deputy Minister, Transport Canada

APPENDIX D:

THE PROVINCE OF ALBERTA

NATURAL RESOURCES CONSERVATION BOARD ACT

NATURAL RESOURCES CONSERVATION BOARD

IN THE MATTER of a project of
Alberta Public Works, Supply and
Services for approval to construct
a water management project (the Project)
to convey and store water
diverted from the Highwood River

BOARD ORDER NO. 9601-1

WHEREAS the construction of water management facilities proposed to convey and store water diverted from the Highwood River by Her Majesty the Queen in Right of Alberta as represented by Alberta Public Works, Supply and Services (APWSS), consisting of four interrelated components:

1. A canal and diversion works in the Town of High River and in the Municipal District of Foothills No. 31. This proposed $6.2 million component would triple the capacity of the existing diversion works and canal to allow more water to be diverted from the Highwood River to the Little Bow River during peak flows.

2. Construction of the Little Bow River dam and reservoir in the Municipal District of Willow Creek No. 26 and in the County of Vulcan No. 2, approximately 20 kilometres (km) west of Champion. The proposed $38.8 million dam would be 25 metres high and create a reservoir that would hold 50,000 acre-feet of water. It would be filled from the natural runoff in the Little Bow River basin and water diverted from the Highwood River.

3. Construction of the proposed $5.1 million Clear Lake diversion and canal in the Municipal District of Willow Creek, about 15 km east of the Town of Stavely. The 10 km long canal would allow the lake and 12 wetlands along the route to be filled when flows in Mosquito Creek are high; and

4. The proposed $7.1 million enlargement of the existing Squaw Coulee Reservoir in the Municipal District of Foothills No. 31 from 293 acre-feet to 5,175 acre-feet by constructing upper and lower dams and a return canal to the Highwood River,
is a reviewable project under s.4(d) of the Natural Resources Conservation Board Act being chapter N-5.5 of the Statutes of Alberta, 1990; and

WHEREAS the Natural Resources Conservation Board may defer consideration of an application on any terms and conditions that the Board may prescribe or make any other disposition of an application that the Board considers to be appropriate

WHEREAS the Natural Resources Conservation Board has deferred a decision respecting the Expanded Squaw Coulee component of the application by Alberta Public Works, Supply and Services for the construction and operation of certain water management facilities on the Highwood River and in Squaw Coulee including the Diversion Plans pertaining to proposed diversion works leading to Squaw Coulee and from Squaw Coulee to the Highwood River and to Mosquito Creek; and the Diversion Plans pertaining to the operation during the low flow season of late July and August of certain expanded diversion works in the Town of High River leading to the Little Bow River, subject to the filing and review of certain supplemental information herein specified.

THEREFORE, the Natural Resources Conservation Board hereby orders as follows:

1. The consideration of the operating plan for the expanded works for the diversion of water at High River from the Highwood River to the Little Bow River during the low flow season is deferred pending receipt and review of additional information as described herein.

2. The consideration of the expansion of the Squaw Coulee Reservoir and associated diversion works and return works is deferred.

3. The Operator shall complete its economic, social, and environmental assessment of the effects of the Super Expanded Squaw Coulee project component within twelve months of the date of issuance of this Order.

4. The Operator shall file with the Board for its approval the plans for the completion of the assessment of the economic, social and environmental effects of the Super Expanded Squaw Coulee project component, including a specific plan for public involvement, within three months of the date of issuance of this Order.

5. The Operator shall update the comparative analysis of potential storage sites within the Highwood River Basin. The comparative analysis shall include among other sites, the Super Expanded Squaw Coulee site, Stimson Creek Site 8 and the Tongue Creek Site 4, and shall include comparative data regarding environmental, social and economic effects for each site identified. The comparative analysis should form part of the completed assessment of the Super Expanded Squaw Coulee Reservoir.

6. The Operator shall, to the satisfaction of Alberta Environmental Protection, revise the IFN analysis used in the Application to reflect current fisheries management objectives for the Highwood River and to include instream flow needs based on the most recent information regarding the River, and current scientific assessment procedures and file the results thereof in the updated assessment of the economic, social and environmental effects of the Super Expanded Squaw Coulee project component.

7. The Operator shall file with the completed assessment of the economic, social and environmental effects of the Super Expanded Squaw Coulee project component an updated plan for the completion of the Highwood River Basin Water Management Plan based on the advice and consent of Alberta Environmental Protection. This update shall include: the design of an independent mediated/facilitated process; the process to identify all stakeholders and their respective community representation; detailed timelines providing for the completion of the HMP planning process within a period of two years; and cost estimates for consulting services and studies related to both parts (design and implementation) of the HMP.

8. The Panel requires that the completed assessment of the Super Expanded Squaw Coulee Reservoir project component include a revised Diversion Plan for works leading to and from Squaw Coulee and for diversion works downstream at High River leading to the Little Bow River.

Made at the City of Edmonton, in the Province of Alberta, this ___ day of _____ ,1998.

NATURAL RESOURCES CONSERVATION BOARD

Contact the Natural Resources Conservation Board at the following offices.
Dial 310.0000 to be connected toll free.

Edmonton Office
4th Floor, Sterling Place, 9940 - 106 Street
Edmonton, AB T5K 2N2
T (780) 422.1977 F (780) 427.0607

Calgary Office
3rd Floor, 640 - 5 Avenue S.W.
Calgary, AB T2P 3G4
T (403) 662.3990 F (403) 662.3994

Email: info@nrcb.gov.ab.ca
Web Address: www.nrcb.gov.ab.ca

Copies of the NRCB Act, Rules of Practice of the Natural Resources Conservation Board Regulation and the Administrative Procedures Act are available through Queen's Printer. NRCB Guides are available by contacting the NRCB's Edmonton office.

ISBN 978-0-7785-7478-1