



# COLUMBIA RIVER TREATY REVIEW



Photo courtesy of C. Morita

## *Libby VARQ Flood Control Impacts on Kootenay River Dikes: Summary*

During the Columbia River Treaty Review public consultation session in Creston on May 30, 2012, the Columbia River Treaty Review team became aware of the community's concerns regarding the erosion of area dikes that protect important farmland and other values. Representatives of the diking and regional districts expressed concern that implementation of Variable Flow Flood Control (VARQ FC) at Libby Dam has resulted in increased bank erosion along the approximately 46 kilometer portion of the Kootenay River that runs from the Canada-U.S. border downstream to Kootenay Lake, which in turn has impacted diking infrastructure located immediately adjacent to the river.

The Columbia River Treaty Review Team contracted BGC Engineering Inc. to undertake an evaluation of these concerns.

### *Study Conclusions*

- ▶ Prior to the construction of Libby Dam, major freshet floods caused extensive damage to the diking system (e.g. 1948). However, since Libby Dam operation commenced in March 1972, average mean annual floods on the Kootenay River, as measured at the Canada- U.S. border, have decreased by more than a factor of two. Peak channel velocities also decreased by a factor of about two following dam construction.
- ▶ Bank erosion rates appear to have increased following dam construction, mainly due to flow ramping which is caused by fluctuations in dam releases that correspond to changes in power demand. Up until 1991, operation of Libby Dam was driven primarily by flood control and power needs. Flow ramping during the fall and winter months was a common practice, when the dam was operated to maximize

hydroelectric power values. Erosion rates appeared to stabilize in the late 1990's when flow ramping restrictions were instituted.

- ▶ A Bank Erosion Assessment performed by Northwest Hydraulic Consultants in 1999, observed that a notch had developed along the Kootenay River banks, which was attributed to flow ramping. This study concluded that "It is considered probable that the development of this notch is more pronounced now that the river level is controlled by Libby Dam in comparison to pre-Libby Dam, when the river level fluctuated over a wider range and the short duration releases from Libby Dam did not occur. The more limited range of water levels, greater fluctuations in flows during the winter season, and more frequent cycles of wetting and drying appear to induce a weakening of the banks resulting in toppling of soil wedges."
  - ▶ Flow ramping at Libby was common practice until the late 1990's, when it was realized that this practice may be having a significant impact on downstream fish habitat. By prescribing maximum ramp rates from Libby Dam in the late 1990's, there has been a considerable reduction in daily flow fluctuations in the study reach. These measures were implemented not only to protect resident fish and prey organisms in the Kootenay River, but also to help minimize dike/levee erosion along the river.
  - ▶ Analysis of Kootenay River hydrographs shows that post-1999 hydrographs are more stable and the rapid water level fluctuations of the past have been eliminated. Therefore, it is not unrealistic to expect bank erosion rates to decrease in the future, as long as flow releases from Libby Dam continue to be managed for both fish habitat and bank erosion. This expectation is consistent with observations by the US Army Corps of Engineers (USACE) who have noted that Kootenai (U.S. spelling)
- River levees in the U.S. are becoming stabilized by vegetation due to the curtailment of flow ramping, especially daily fluctuations, since 2000.
- ▶ Peak flow velocities during VARQ FC remain well below the pre-Libby Dam period. The pre-dam period is considered to be a better measure of typical shear stresses that induce meaningful channel changes (i.e. scour and bank erosion) along this section of the Kootenay River.
  - ▶ It is BGC's opinion that the implementation of VARQ FC has not had a significant negative impact on diking infrastructure adjacent to the Kootenay River between the Canada- U.S. border and Kootenay Lake. In contrast, the past practice of flow ramping did have a significant negative impact on diking infrastructure.
  - ▶ It is also noted that peak freshet flows and channel velocities were well above average in 2011 and 2012. These above average flows may have resulted in some bank erosion along the study reach, increasing the perception that VARQ FC has had a negative impact on diking infrastructure. In the U.S., the USACE observed some levee damage along the Kootenai River in 2011 and 2012. The USACE attributed this damage to a long duration snowmelt in 2011 and above average snowmelt in 2012 compounded by above average rainfall in June 2012. In both years, these conditions resulted in saturated dikes that were more susceptible to erosion.