

Executive Summary

What Occurred: In spring 2006, conditions and Libby Dam operations in the Kootenai River Basin resulted in a flood event affecting areas downstream of Libby Dam in Libby and Troy, Montana and in Bonners Ferry, Idaho. Libby Dam released flows at or above powerhouse capacity (approximately 25,000 cfs) for the period from May 17 to June 30. In response to erosion of levee banks and potential failure occurring at river stages below the designated flood stage, a flood emergency was declared on May 19, 2006, and the U.S. Army Corps of Engineers (Corps) began to provide technical and direct assistance to the local communities. At that time, the Corps could not meaningfully reduce outflows from Libby Dam because of remaining snowpack and thunderstorm activity, and concerns about filling the reservoir and diminishing flood capacity. Spillway flows above powerhouse capacity at Libby Dam were released from June 8 until June 27, with peak spillway flows of 31,000 cfs on June 18. At Bonners Ferry, the river stage was within 1 foot below flood stage of 1764 feet on May 21 and 22, and exceeded flood stage from June 16 to June 22. The peak river stage at Bonners Ferry was 1766.6 feet on June 18.

Purpose of this Report: The Corps' After Action Report (AAR) summarizes the facts leading up to, during, and following the 2006 flood event in the Kootenai/Kootenay River Basin. It is intended to provide information concerning: (1) Libby Dam water management decisions in 2006 prior, during, and after the 2006 flood event; and, (2) the activation of the Emergency Operations Center (EOC), and the response to requests for emergency assistance in the Kootenai River downstream of Libby Dam. This AAR also includes Lessons Learned from the 2006 flood event, recommended actions to address future decisions on Libby Dam operations, as well as suggested improvements for the Corps' emergency response and communications. The AAR is intended to provide understandable information for the general audience, however, it necessarily includes technical information concerning the 2006 operation as well. There is additional technical detail provided in the supporting appendices.

Contents of this Report: The first chapter provides background information on the Corps' responsibilities for the operation of Libby Dam for multiple objectives and addresses areas impacted in the Kootenai River Basin, including downstream of Libby Dam and the local levee system. Chapter 2 discusses the conditions and factors considered in making real-time decisions for Libby Dam operations from January to July 2006. Chapter 3 describes the emergency actions taken by the Corps, while Chapter 4 contains retrospective observations concerning estimated damages prevented, and effects on resident fish in the river below Libby Dam and on the Kootenai River white sturgeon (sturgeon) further downstream. The final chapter presents the Corps' conclusions, as well as a summary of Lessons Learned from the 2006 flood event and a discussion of actions the Corps will undertake in response.

Chapter 1. Background Information

As one of the fourteen Federal Columbia River System Projects (FCRPS), Libby Dam is operated by the Corps for system and local flood control, hydropower generation, navigation, recreation, fish and wildlife, in manner consistent with applicable federal and state statues, regulations and treaties. Those most relevant to the operation of the FCRPS and Libby Dam are the Columbia River Treaty, the International Joint Commission (IJC) 1938 Order on Kootenay Lake, and responsibilities pursuant to the Endangered Species Act (ESA), the Clean Water Act (CWA), and the Pacific Northwest Electric Power Planning and Conservation Act (Northwest Power Act).

The Corps, the Bureau of Reclamation (Reclamation), and Bonneville Power Administration (BPA) (collectively the Action Agencies) consulted with both the U.S. Fish and Wildlife Service (USFWS), and National Marine Fisheries Service (NMFS or NOAA Fisheries) to address the effects of the operation of FCRPS projects, including Libby Dam, on ESA listed species and their designated critical habitat. The 2006 USFWS Libby BiOp includes a Reasonable and Prudent Alternative (RPA), with a performance-based approach for achieving habitat attributes to promote sturgeon spawning and recruitment. The USFWS RPA recommends long-term implementation of VARQ flood control, development of a protocol for evaluating of sturgeon flows, as well as flow operations for bull trout.

For listed anadromous species (salmon and steelhead), the Action Agencies submitted the 2004 Updated Proposed Action to NOAA Fisheries, which considered and concluded in the 2004 NOAA FCRPS Biological Opinion that the action would avoid jeopardy. Included in the action was implementation of VARQ Flood Control with the objective of increasing the probability of refilling the reservoir to assist in meeting salmon flow objectives during July and August.

Since December 2002, the Corps has been operating Libby under VARQ Flood Control (VARQ FC) on an interim basis until completion of the EIS process for a decision regarding long-term Libby Dam operations. Under the VARQ Flood Control Operating Procedures, the Libby Dam reservoir elevation is held higher than under the Standard Flood Control Procedure, given a certain range of “normal” snow pack conditions during the January to April period. The VARQ procedures identify sufficient discharges from Libby Dam during the refill period in the spring to accommodate the remaining runoff of the snow pack. The intended benefit of the VARQ Flood Control Operating Procedures is to have adequate water available to provide flows for sturgeon through the spring freshet, and for summer flow augmentation for salmon in the Columbia River.

Flood damage reduction in the Kootenai River Valley depends upon both Libby Dam operations and a system of non-federal levees extending from Bonners Ferry to the Canadian border. In addition to operating to reduce system-wide flood damages, the Corps operates Libby Dam releases to avoid exceeding the Bonners Ferry flood stage elevation designated by the National Weather Service - currently 1764 feet.

Chapter 2. Overview of the 2006 Spring Flood Event

During the 2006 flood event, the Kootenai River Valley experienced a seasonal runoff volume that was slightly above average. However, the shape of the runoff was unusual due to several factors. Record temperatures in the basin in mid-May resulted in very rapid snowmelt and peak inflows during the second and third week of May. In addition, rainfall during the second half of May and the first part of June was above normal in the Kootenai Basin. In particular, record rainfall of up to 266% of normal occurred in the Libby Dam area in June.

With 2006 being forecasted as an average or normal water year, Libby Dam was operated under the interim VARQ Flood Control Operating Procedures. VARQ FC is comprised of two components: the draft or drawdown period (January through approximately April), and the refill period (approximately April through July). During January through March, 2006, Libby Dam was operated to achieve system flood control objectives, including following the VARQ Flood Control Drawdown Guidance, and the end-of month upper flood control elevations.

VARQ operations were expected to transition from the drawdown period into the refill period sometime between April and May. On April 19, VARQ Refill Guidance was issued recommending the release of 16,400 cfs. However, to meet multiple objectives, a decision was made to continue releasing 4,000 cfs rather than those recommended in the April VARQ Refill Guidance. This decision was based on the following factors:

- The seasonal Water Supply Forecast issued in April was 6.076 MAF. This is 97.2% of normal.
- The calculated end of April flood control upper limit for the Libby Dam reservoir was elevation 2417 feet. As the end of month elevation was expected to be at a lower elevation, releasing minimum outflows did not appear to pose a risk to local flood control. The actual end of April reservoir elevation was 2413.2 feet - 3.8 feet below the end of April flood control elevation.
- The Corps evaluated the risk associated with shaping the VARQ Refill Guidance outflows using Libby Dam inflow forecasts and other modeling tools. This information indicated the risk was low that local flooding would occur.
- In late April, the Columbia River was operated for system-wide flood control as a result of high flows in the lower Snake River. From a system flood control perspective, therefore, additional inflow to the Grand Coulee reservoir from upstream projects, such as Libby Dam, was not advisable.
- The ongoing regional discussions with the federal and state agencies had not reached resolution on which sturgeon operation to implement to achieve the habitat attributes for sturgeon as described by the USFWS 2006 BiOp – stacked flows or powerhouse plus 10,000 cfs.

In May, with an agreement concerning the “stacked flow” operation for sturgeon, Libby releases were increased reaching 25,000 cfs, or full powerhouse, on May 17. However, rapid snowmelt occurred because of record warm temperatures in the mid- May, with peak inflows to the reservoir of 77,000 cfs on May 21. The river stage at Bonners Ferry at this time was 1763.5 feet. The Corps continued releasing 25,000 cfs through the remainder of the month of May to

slow refill and allow for uncertainty in projected inflows in June. At the end of May, the Libby reservoir was at elevation 2449.8 feet, 9.2 feet from full.

The June final water supply forecast increased to 6.766 MAF, which was 108% of normal. At that time, the information available, including inflow forecasts, indicated that the Libby reservoir could draft while continuing to release 25,000 cfs. However, significant thunderstorm activity resulted in greater than forecasted inflows, and spill was initiated on June 8. Inflows to the Libby reservoir increased over the next few days because of continuing thunderstorm activity in the basin upstream of Libby. On June 18, the reservoir was near full and spill was increased to 31,000 cfs for a total outflow from the dam of 55,000 cfs. The reservoir reached elevation 2459.10 feet on June 18 for approximately 24 hours and the river stage at Bonners Ferry peaked at elevation 1766.6 feet. By June 20, inflows and river stage levels began to recede, and spill levels were reduced slowly to minimize sloughing of levee embankments downstream. Spill ended on June 27.

Chapter 3. Emergency Operations

On May 16, 2006, the Corps activated the Emergency Operations Center (EOC) in response to the Kootenai River Basin flood, and the Corps' flood team deployed and began providing technical assistance to the Bonners Ferry community. Deployment was based on reports of increased snow pack melt and runoff in tributaries to the Kootenai River, as well as a verbal request from Boundary County officials. On May 19, LTC Leighow, Acting District Commander, declared a flood emergency. The Corps' flood team began providing direct assistance in addition to technical assistance to the Bonners Ferry community.

The Corps expended over \$1.4 million on emergency response activities in the Kootenai River Basin. Emergency services included direct and technical assistance with emergency levee repairs in the Bonners Ferry community, delivering over 80,000 sandbags to the local community, as well as technical assistance to property owners and the local, county and State governments.

Direct assistance furnished by the Corps included emergency levee repairs to the right bank levee downstream of the Highway 95 Bridge in Bonners Ferry. The levee was severely damaged during the initial high Kootenai River flows in May 2006 and complete levee failure was imminent. A levee breach would have resulted in major flooding of the North Bonners Ferry community.

The Kootenai River flood team assisted Boundary and Lincoln Counties with technical assistance throughout the flood event. Examples of technical assistance provided included instructing and directing sandbag operations on the Moyie and Kootenai rivers, providing flood proofing recommendations to individual property owners, assisting the Burlington Northern railroad with an erosion protection plan, and assisting local governments with flood response planning. These flood teams continued to provide assistance to both the States of Idaho and Montana until the EOC ceased operations on June 28.

Chapter 4. Observations from the 2006 Flood Event

The area downstream of Libby Dam is a relatively complex hydrologic system of approximately 100 miles of levees. The effect of 2006 Libby Dam operations on damages prevented at downstream locations in the Kootenai River Valley is determined by comparing regulated (conditions with Libby Dam) and unregulated (conditions without Libby Dam) river stages at selected sites. This year damages prevented are estimated at \$27 to \$45 million but this estimate does not include the cost of flood fighting, damage to non-federal levees, and seepage damage, nor any impacts in Canada.

Total dissolved gas (TDG) saturation in the Kootenai River downstream of the dam and above Kootenai Falls near Troy, Montana, increased as spillway flows began on June 8 and increased to a peak spill of 31,000 cfs on June 17. The TDG saturation exceeded 110% on June 8, reached 124% on June 16, and peaked at about 130% between June 17 and June 20. TDG saturation dropped back below 110% on June 27 when spill ended.

Montana Department of Fish, Wildlife, and Parks monitored fish in the Kootenai River for symptoms of gas bubble trauma (GBT) several times during spillway releases at Libby Dam in June 2006. Preliminary results indicated that GBT symptoms were detected in almost all resident species after two weeks of sustained spill. Over time, exposure to high TDG saturation results in increased frequency and severity of GBT symptoms.

The Idaho Department of Fish and Game monitored sturgeon movement during the spring of 2006. While more will be known in about two to three years as to whether successful sturgeon reproduction occurred in 2006, at least five tagged sturgeon moved upstream of the Highway 95 bridge this year. Further, sturgeon eggs were found near Bonners Ferry, not far downstream of the highway bridge and spawning in the Shorty's Island reach was documented by capture of eggs on egg mats.

Chapter 5. Summary

The Lessons Learned from the 2006 flood event are summarized in the following discussion addressing Libby Dam Water Management Operations, Emergency Management Operations, and Public Affairs and Communications.

A. Libby Dam Water Management Operations

As part of the Corps' review of the 2006 flood event, the Corps conducted post-event analyses. The analyses indicated that no spill would have occurred in 2006 if the Corps had been operating in strict accordance with the VARQ Refill Guidance, i.e. without utilizing flexibility to shape flows to accommodate operational objectives for system-wide flood control and for listed sturgeon and salmon, and assuming the same stacked flow operation would be implemented.

The Corps is committed to evaluating the risks associated with exercising flexibility to shape flows identified in the VARQ Refill Guidance, as well as evaluating risks associated with constraining this flexibility. To improve the assessment of risk in decision-making, the Corps

will address a wide-range of potential adjustments needed for a variety of considerations including system-wide flood damage reduction, levee erosion, transmission line restrictions, unit outages, listed species operations and/or other unforeseen circumstances.

Informed operational decisions require having the best available information on water supply conditions and weather forecasts. In 2006, the Corps utilized a variety of tools and models to assess operations and analyze the risks associated with shaping flows. As a result of the 2006 flood event, the Corps will reevaluate the use of these tools, and analyze other methodologies upon which to make in-season management decisions. The National Weather Service's River Forecast Center (RFC) is undergoing an extensive review of the available tools and the Corps will cooperate with the RFC in their review.

Critical considerations for the 2006 operational decision-making were meeting ESA responsibilities. A preliminary review and analysis of interim VARQ in water years 2003 to 2005 indicates that without exercising flexibility or shaping releases to take into account other factors, the objective of refilling the Libby reservoir to provide summer flow augmentation for salmon would have been compromised. On the other hand, the review of the 2006 year indicates that exercising flexibility in the implementation of VARQ resulted in releasing 55,000 cfs and spilling from Libby Dam.

The Corps will take a hard look at the procedures and the effects of implementing VARQ to provide for the desired objectives for listed species, while also addressing system and local flood damage reduction. The Corps will provide this information to the USFWS, NOAA Fisheries, stakeholders, and the public.

B. Emergency Management Operations

Public safety remains the Corps first priority and the Corps will review internal processes to ensure that the appropriate actions required for flood damage reduction related to project operations are taken. Emergency response activities to this year's flood event began when the Kootenai River was below the flood stage of 1764 feet as measured at Bonners Ferry and when areas in the City of Bonners Ferry were threatened by flooding.

The Corps will review internal processes to ensure that the appropriate actions required for flood damage reduction related to project operations are taken. In particular, it will review funding of flood response when the project is being operated for multiple purposes such as meeting power demand or meeting ESA responsibilities. The Corps will develop a plan to evaluate options for reducing the risk of flood damages while also providing for other project purposes. Options could include emergency response assistance and consideration of outflow reductions at the dam. This assessment will be fully coordinated with local emergency officials so they can plan accordingly.

The Corps has begun collecting information about the current condition of the non-federal levees and will provide this and other information about the 2006 flood event to the National Weather Service for their use in reviewing the flood stage at Bonners Ferry. If the National Weather Service recommends a different flood stage at Bonners Ferry, the Corps will

examine what effect, if any, the recommended change in the Bonners Ferry Flood stage may have upon future Libby Dam operations.

Flood damage reduction in the Kootenai Valley depends upon both Libby Dam operations and a system of non-federal levees. In June, 2006, Boundary County and the City of Bonners Ferry requested Corps evaluations of their levees for inclusion in the PL 84-99 non-federal levee program. Seattle District has initiated the levee evaluations and plans to have the initial levee reports completed by January 2007. The intent of the evaluations is to assess the current condition of the levees, provide levee improvement and maintenance recommendations to the sponsors, and to determine if the levees meet the eligibility standards for the Corps non-federal levee rehabilitation program. If the levees are included in the Corps' rehabilitation program, the Corps can assist the City and County with future flood damage repairs.

C. Public Affairs/Communications

During the spring flood event, there were instances of miscommunication or incomplete coordination as to water management actions, and changing field conditions within the Corps. A review of the Corps' communication processes indicated areas in need of improvement. The Corps will review existing processes for communicating risk management with the public and within the agency. Libby Dam project staff will be augmented to assist and provide support during major flood events.

The Way Ahead

The Corps is committed to providing safe and reliable operations at Libby Dam to fulfill its responsibilities to meet congressionally authorized uses. The AAR was prepared to factually report the events leading up to and resulting in the 2006 flood event, and to identify lessons learned so that decision-makers will have the benefit of this information for the future.

The Corps' initial assessment of interim implementation of VARQ Flood Control Operating Procedures in this AAR identifies several actions concerning the tools and processes used for risk assessments, as well as assessing information on the condition of the local levee system, effects on resident fish, and examining how best to achieve the desired objectives for listed species while also addressing system and local flood damage reduction.

The Corps will implement these actions and apply the information to determine near-term and long-term Libby Dam operations. For 2007, the Corps will consider all available information and public input before making a decision on the appropriate flood control operations. This process will be completed by December 2006. For the long-term decision on Libby Dam operations, the Corps is committed to thoroughly examining the array of analyses, factors, and considerations necessary to make a decision on adoption of an alternative in the Final Upper Columbia Alternative Flood Control and Fish Operation EIS.